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TOOLS AND TECHNIQUES OF PLANNING
AN INTRODUCTION

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An Introduction

D. BRIGHT SINGH

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Preface

India's experience in planned economic development in the last three decades or more has not been one of uniform success. Undoubtedly much care has been bestowed on the methods of planning as well as on the formulation of suitable policy measures. But what has been achieved so far falls short of the ideal. The failure to reach the targets set in the plans and the difficulties and problems which came up in the course of planned development and which were not previously envisaged drew attention to the important fact that in the context of the socio-economic and administrative set up in the underdeveloped countries, the modern sophisticated techniques evolved mostly in the industrial countries cannot be adopted in toto but required modification and adaptation. If any modification of the techniques is needed and if it is felt that in this exercise not only specialists in the field but members of the enlightened public are also to be enabled to make their contribution, the latter should have to be made familiar with the basic principles underlying these techniques. In this book, I have tried to depict in an outline from the broad features of the tools and techniques of planning which are commonly used. The description is not detailed or exhaustive, but I hope the account given here will serve as an introduction not only to the student who intends specializing in the subject but also to the educated and intelligent general reader.

The contents of the book fall into four divisions. Chapter I and II are of an introductory nature. The next four Chapters deal with the quantitative methods of planning—the econometric model, linear programming, commodity balances and input-output analysis. The objective which is common to these methods is optimization of resource use, and the ensuring of consistency in sectoral development programmes. This is followed by three chapters—Chapters VII, VIII and IX—which give a brief account of certain important aspects of economic planning and the concepts used therein. The administrative problems arising in the course of preparation and implementation of development programmes are examined with special reference to India in the concluding chapters.

My association with the Tamil Nadu State Planning Commission as its Full Time Member for more than ten years provided the opportunities of understanding the nature of the planning problems which a political unit in the federal set up of a developing country has to face. In the course of my service I had the good fortune to get the co-operation and assistance of some senior government officers and benefit by their experience and knowledge. I acknowledge my indebtedness to them, particularly to Mr. S Venkataramanan, I.A.S., who suggested to me the writing of the book and encouraged me in the initial stages of the work. I should also place on record the invaluable help in statistical analysis which I received from Mr. R Bhaktavatsalu and Dr. V Soundararajan. Dr. E Max, Reader in Econometrics, University of Madras, went through the final draft of some chapters of a technical nature and made useful suggestions for their refinement. My thanks are also due to Mr. T S Ramakrishnan, the Librarian of the State Planning Commission for his unfailing courtesy and co-operation in the collection of data and in checking up references, and to Mr. R Krishnamurthi for his neat execution of the typing work.

D. BRIGHT SINGH

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CHAPTER 1

Economic Backwardness and the need for Planning

The major problem of the under-developed countries is their poverty. The low income countries are mostly in the tropical regions of the world and their natural resources are not abundant. Scarcity of capital is reflected in the low productivity of labour and its low earning power. This, combined with over population has caused large-scale under-utilisation of human resources. Most of the poorer countries of the world are only in the initial stages of industrialisation and the majority of the people live in villages. More than 50 per cent of the income in these countries is generated in the agricultural sector which is considered a relatively depressed sector not only in under-developed countries but in developed countries as well.

Very low per capita income affects all aspects of life of the people. Health and educational standards are very low. Expectation of life is short compared with advanced countries and child mortality rate is high. The very slow progress of urbanisation and the predominance of the primary sector in the national economies account for the social backwardness of the people. Superstition, lack of social mobility, adverse institutional factors and an other-worldly attitude on the part of the people have operated for long as serious obstacles to material progress and economic advancement.

Planning for development in these countries therefore has two aspects—(1) the eradication of poverty and all the socio-economic ills associated with it, and (2) ensuring a higher rate of growth of income. This makes economic planning a far more complicated and arduous task than in industrialised countries. In the latter, since per capita income is already high, and since the industrial sector contributes a larger share to national income than the other sectors, further expansion becomes relatively an easy task. These countries, in Prof. Rostow's apt and meaningful phrase have taken themeselves off into self-sustained growth. In them, economic progress is automatic and has an on going character. Growth is self-sustained or generated by forces working within, and hence the objective of planning is to maintain the high rate of growth or to raise it further and to ensure stability in the process of growth.

If the main concern is to accelerate income growth and maintain stability then the approach to planning becomes essentially a quantitative one wherein reliance will be placed on the manipulation of variables whose values can be expressed in quantitative terms. The early exercises in planning in India were based on the acceptance of the usefulness and reliability of quantitative models. The crucial factors underlying such an approach are, rate of income growth, rate of savings and investment and the quantitative relationship between capital growth and income growth. The argument in support of this principle would then run in terms of the cause and effect nexus between investment on the one hand and income increase on the other. In many of the under-developed countries, population is large in relation to the size of the country and the resources available are limited and the per capita income is very low. Since per capita income is low and the propensity to consume is high, savings margin is very narrow and hence the rate of capital formation is low. As a result, the rate of growth of the economy or the annual increase in the output is small, which means that per capita income will continue to be low. In order to break themselves out from this vicious circle of low income, low savings and low rate of capital formation, the investment rate should have to be raised to a level appreciably higher than what it is now to ensure an income growth higher than the demographic rate. It is obvious that unless the per capita income growth rate is higher than population growth rate, no economic progress is possible. Hence in the initial stages, a poor economy should have to strain itself greatly in order to find the real resources for purposes of investment. Although these countries are receiving substantial assistance from foreign countries for financing their development programmes, yet, by and large, they have to lift themselves up by their own bootstraps. All this would mean that given their limited resources, particularly capital and natural resources, planning in these countries should aim at the better mobilisation and husbanding of these resources and directing them into those channels of investment which would ensure rapid development. It is only by making each unit of land, capital and labour yield larger returns, that the economy can transform itself and find a place in the Harrodian world of developed economies.

Accordingly, India's development plans until recently laid great emphasis on income growth as the major objective. Programmes for the development of the agricultural and industrial sectors were designed to bring about a rapid increase in the output of these sectors. In the Second and Third Five-Year Plans, and in the subsequent Annual Plans, much attention was devoted to the building up of heavy industries and the economic infrastructure. It was assumed that these developments would set in motion the forces of growth and in course of time as a result of increase in employment opportunities, income of all the sectors would also go up, and that the benefits of economic progress would seep down to the masses. Improvement in the material well-being of the people, in literacy and in health standdards, would awaken their enthusiasm for economic improvement and make them put forth the necessary efforts to attain this end.

This however has not happened. Since the commencement of the First Five-Year Plan our industrial and agricultural production has increased substantially. India today is rapidly becoming an industrial country. The contribution of industries and business has increased from about one-twentieth of national income—before Independence to about one-third now. In fact, industrial growth has been one-third faster than the growth of the economy as a whole. The value of agricultural output went up from Rs.4160 crores* to Rs.14905 crores in the

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*One Crores = 10 million

20-year period since 1950-51. Between 1960-61 and 1980-81 there has been a 46 per cent increase. More than two-thirds of the industrial output now consists of capital goods and intermediaries as compared with 25 per cent to 30 per cent in the early 60s. Foreign trade increased from Rs.1972 crores in 1950-51 to Rs.3169 crores in 1970-71 and to Rs.15,367 crores in 1979-80.[1] But while in the fifties imported manufactured goods accounted 35 to 40 per cent of the country's requirements, the proportion has now declined to less than 10 per cent. India has become an exporter of some types of capital goods, and as regards manufactured consumption goods, imports have been practically displaced by domestic production. At 1970-71 prices India's national income was Rs.16,731 crores in 1950-51, Rs.24,250 crores in 1960-61, Rs.34,235 crores in 1970-71 and Rs.46,636 crores in 1978-79.[2] Correspondingly, per capita income moved up from Rs.558.8 in 1960-61 to Rs.632.8 in 1970-71 and to Rs.727.6 in 1978-79.

Against these achievements have to be mentioned certain significant failures. While per capita income (which is the average for the country) has increased, there has been little change in the extent of poverty in the country. Poverty in the worst forms has not been eradicated. According to the Draft Five-Year Plan 1978-83, the number of people below poverty line, i.e., people getting a per capita income of less than Rs.40 a month was estimated at 290 million or 46.33 per cent of the total pupulation.[3] A recent finding based on the definition of poverty line as Rs.65 per capita per month at 1977-78 prices for the rural population and Rs.95 for urban areas shows that 54.09 per cent of the population in rural India and 41.22 per cent in the urban sector live below the poverty line.[4] A reference to the many estimates made in the past few years of the proportion as well as the absolute number of people below poverty line in India reveals a disappointing trend. These estimates vary, but it is safe to conclude that the proportion of the people below poverty line in the last ten years or so has at best remained constant (about 60 per cent) or possibly has increased, but it is not likely to have declined. Also, it may be added that whatever may be the method of approach adopted, there is ample evidence to indicate that the absolute number has not decreased.

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[1] *Reserve Bank of India Bulletin*, June 1981, PS 331 Corresponding provisional figure for 1980-81 is Rs.18,885 crores.

[2] The provisional figure for 1979-80 is Rs.44,328 crores.

[3] Draft Five-Year Plan of India 1978-83, Planning Commission, Government of India, 1978, pp. 3 and 50.

[4] *Indian Express*, 13 March 1980—as reported by the Prime Minister to the Lok Sabha.

As regards disparity in the distribution of income the ideal of social justice and equality still remains an ideal. In fact, the trend in the proportion of people below poverty line corroborates the view that the disparity in this regrad has not in any way been reduced. While the top 10 per cent of the population accounts for almost 30 per cent of the total consumption, the bottom 40 per cent accounts for less than 20 per cent. Looking at the same matter from the point of view of the income distribution it is seen that while 50 per cent of the population gets only one-fifth of the national income, 5 per cent people at the top alone account for one-fifth of the national income. The Green Revolution about which much has been said and written in recent years has benefited only the big farmers and has contributed to the widening of the income difference in the rural areas. Failure to implement land reform measures accounts for the continuance of disparity in land holdings. Land is still concentrated in the hands of a relatively few agriculturists with 40 to 60 per cent of the farms being cultivated by part or full time tenants.

The position in respect of unemployment has also deteriorated. At the commencement of the First Five-Year Plan, unemployment in the country was of the order of about 3 million. It increased to about 5 million at the beginning of the Third Plan and to about 8 million five years later. At the start of the Fifth Five-Year Plan, i.e., in 1973-74 unemployment was estimated at 18.57 million, and in 1978 at 20.56 million.[1] It should be added that these figures do not include disguised unemployment.

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[1] Draft Five-Year Plan, 1978-83 Planning Commission, Government of India, 1978, p. 94.

All this would mean that the masses have not benefited by the planned development that has taken place so far, and as such, it is idle to expect any social or attitudinal change on their part. In other words, judged by the test of amelioration of the economic conditions of the masses, little has been achieved so far.

All the same, eradication of social ills should in the present context be the main objective of any programme of development. In the effort at economic betterment, the human factor has to play a decisive role. Of the three factors of production—land, human resources and capital, the first two are the gift of nature and the third one—a man made. At one time in the history of the world all countries were poor judged by modern standards. As population increased, the availability of natural resources per individual worker progressively decreased. However, to the extent human ingenuity, skill and diligence succeeded in building up capital, the addition of capital equipment per worker helped in offsetting the adverse effect of decrease in natural resources per head. But if this opportunity to build up capital is missed, population growth tends to outstrip income growth, and the country would find it increasingly difficult to reverse the trend. The low income countries of today are mostly in this category. The important point to note here is the significant role of the human factor. There is no need to stress the obvious fact that in all advanced countries labour is diligent, hard working and enterprising, whereas in the poor countries, labour productivity is low and therefore earning power of labour is low not so much because capital equipment per head is limited as because labour is indifferent and lethargic and the people in general are not impelled by the motive of acquisition and material advancement as those in the countries like USA, Canada, Germany or Japan.

Yet, it is said that India's valuable asset is its teeming millions and the main problem of economic development in the country is—moving the masses. In the present context in India, this would imply the awakening of the masses to the need for economic improvement and creating in them the necessary incentive to work harder, increase their earning power, to save and accumulate and raise the standards of their material well-being and thereby build up the nation's economy. It should be the purpose of economic planning in under-developed countries to bring about this social transformation.

Viewed in this manner, economic planning has a much wider scope than if it is conceived as an exercise at formulating methods of utilising the real resources of the economy in a manner that would maximise the benefit in the form of larger national product. In other words, planning is not to be restricted to the economic activities of the country but should extend to the social and cultural sides of life as well. It should aim not merely at the building up of industries and developing of agriculture but at the total well-being of the nation. For this reason, planning, while it becomes more comprehensive becomes also more complicated. It has to concern itself with all aspects of life and all classes of people and has to find means of solving an increasing number of problems, both economic and social.

But while the task of planning has become intricate and has assumed new dimensions in under-developed countries, the circumstances in which the planners have to work are found to be not congenial. They have to labour under special difficulties and constraints from which their counterparts in advanced countries are free. In particular, mention should be made of the inadequacy of the administrative machinery. In our country the form and structure of administration is a heritage of the past going back to the days of British rule. The main task with which the governments at the district, provincial and central levels were entrusted was collection of revenue and maintenance of law and order. It should in fairness be stated that from the point of view of administrative efficiency, the system that we have inherited is as good as can be desired. But this machinery which has served well all along, is now found to be inadequate to meet the needs of a planned economy. Today mere administrative efficiency is not enough. Economic development to which so much attention is given now, requires an administrative set up which, apart from preserving law and order and mobilising revenue resources should also actively contribute to the organisation of an economic system favourable to economic growth. Planning for development involves structural changes; building up the economic and social overheads; working out methods of increasing agricultural production; improving the educational system; building up of industries, promoting entrepreneurial skill; providing better public health and medical facilities; bringing about social and attitudinal changes on the part of the people; in fact, laying the foundations of rapid economic growth and building up the economy along sound lines.

In this regard, the form of the government under which the plan has to be formulated and implemented also matters much. Theoretically, economic planning is likely to be more successful in an authoritarian set up than in a democracy. In a Communist country, planning is authoritarian and rigid in the sense that economic activity in every sector and subsector is designed and determined by the Central Planning authority. When once the economic plan is drawn up, its implementation is carried out in strict conformity with the directions and regulations contained in the plan. Since the means of production are owned by the State and market competition does not exist, and the State has the powers to determine the pattern of consumption of the community, it is easy for the planning authorities to regulate production and consumption in a manner that ensures proper balancing between the two. Investment allocation among the different sectors is determined by the central authority and the size of output of each sector, the time schedule for production, the distribution of the output and the prices are all fixed in advance. Besides, any possible divergence between production and final demand is removed by means of price adjustment and by controlling distribution. Thus one important source of uncertainty which bothers the planner in a free enterprise economy or market economy is removed. On the other hand, planning in a democratic country, cannot be rigid or authoritarian. In mixed economies, there is quite an extensive area of free enterprise over which the government has little direct control. Even in the public sector, government's control is to some extent limited inso far as the public sector has to compete with the private sector in procuring resources and in disposing of the end product. The investment activity in one part of the economy, namely, the Government sector, is determined by the State but as regards the private sector, regulation is possible only in an indirect way by means of controls, taxation, payment of subsidies, restrictions on imports, licensing, rationing of materials, etc. With all that, there is ample scope for competition among independent productive agencies as well as between the two sectors—(the government and the private). As a result, there is always the likelihood of wrong estimates being made regarding supply and demand, and this causes instability in prices, unemployment and other allied evils.

Democratic planning is said to be broadbased. In theory, if planning is to be democratic, the approval and active co-operation of the people are required at the stage of formulation as well as implementation. But it is doubtful whether economic planning can be truly democratic. The work in connection with the formulation of plan projects and the drafting of the plan is of a technical nature and has necessarily to be done by experts. In a democratic government the draft plan is placed before the legislature whose criticism is taken into account in finalizing the plan. In this sense the plan may be said to be based on the co-operation and approval of the people and to that extent it is democratic. But if the legislature or the public is not competent enough to actively participate at the formulation stage, the plan is likely to be put into execution by the government assuming that it has the public approval.

The basic prerequisite for the successful functioning of democracy is an enlightened public, conscious of its responsibilities, and duties as much as of its rights and privileges; interested in public matters, and disciplined and capable of offering constructive criticism on matters of government policy. In many of the present day under-developed countries, the democratic form of government which they have adopted is relatively new. The majority of the people in these countries are illiterate and there is a perceptible tendency on their part to place their rights and privileges before their responsibilities. These traits of character undoubtedly affect the successful working of democracy. For the same reasons, it is unlikely that the public would evince any real interest in development planning. While the masses may be aware of what the government is doing in this direction, they may not get involved in it or realise their responsibility for co-operating with the government agencies in the implementation of the plan.

Planning in under-developed countries is handicapped in yet another way. The sophisticated techniques of planning such as the Input-Output analysis and econometric methods have been evolved and refined in advanced countries and have been practised with success in these countries. The reliability of an econometric model depends on the quality of the statistical material available. Detailed statistical data relating to industries, finance, flow of funds, sectoral output and demand, agricultural production, employment, prices, exports and imports, etc., are regularly prepared with a high degree of accuracy and kept up to date in these countries. Moreover, statistical information is collected not only by government agencies but also by private industrial concerns, Research Institutions and other similar bodies. With such adequate and reliable data it is possible to draw up detailed sectoral programmes, analyse the costs and benefit side of the projects and incorporate and make use of the materials in the construction of mathematical models.

But in under-developed countries, statistical information is inadequate and leaves much to be desired in the matter of accuracy. In particular, the defects of Indian statistical data are delayed availability, lack of reliability and deficiency in coverage and in the methodology used. Final estimates of state income figures become available only after a lag of two or three years. This delay happens mainly because of the time taken by the various departments to furnish the basic data. In the agricultural sector, area figures are brought out only one year after the period to which they relate because the final settlement of village accounts is done only in the month of July after the *fasli* year* is over. Figures pertaining to forestry are prepared after the administration reports are finalised which takes up a period of three to six months after the year with which the reports deal. Apart from delayed availability of data there is also the problem of limited reliability. Concerning the agricultural sector, the area figures are not found to be correct. The yield data relating to animal husbandry are usually out-dated. Surveys for estimating the yield are not being conducted as frequently as necessary to reflect the true picture of the yield. As regards fisheries, there is no proper method for the assessment of yield of the inland fisheries and the estimates at present furnished by the Fisheries Department are not based on any scientific survey.

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*July to June.

The industrial sector bases its data on the Annual Survey of Industries which is compiled from filled-in-returns received from the industries. For sending this data the industries take two to four years. In manufacturing, for the purpose of the Annual Survey of industries, all the factories coming under the census sector are fully covered, but of the sample sector, only one-third is covered and estimates are made for the rest two-third on the basis of the number of workers employed. The present method is suitable for labour intensive industries, but not for capital intensive industries. Income from the service sectors is estimated by multiplying the working force and the average earnings per head. But the information relating to per capita earnings is not quite reliable.

Further, the methodology used in collecting the data is not quite satisfactory and the coverage is not wide enough. For agriculture, details of expenditure on input items like chemical fertilisers are furnished by the Central Statistical Organisation on the allocation basis which may not be correct. Regarding organic manures, information is collected from the National Sample Survey reports prepared some years ago. No recent study has been undertaken. As regards animal husbandry, the estimate of the cost of feed is based on an out-dated survey. The subsequent changes in feed pattern have not been taken into account. For small enterprises, the returns are computed on the basis of the size of the working force and value added per person; but value added per person does not seem to be correct. Working force estimates are made by using the census figures, but differences in the definition of workers in the census make the estimates unreliable. As for costs and value of construction works, the commodity flow approach is adopted. Income from construction is calculated by taking into account the working force and the average earnings per head, but the working force estimates which are based on the census data are not accurate since the migration of workers from one state to another and the changes in occupation are not allowed for.

The litany of shortfalls in our statistical data can continue at length but the main point to note is that this constitutes a serious gap in our factual information and thus prevents full use being made of some of the modern techniques of planning. In conclusion, it should be stated that although the problems connected with economic development in low income countries are more numerous and complicated than in the richer industrial countries, and although social and economic backwardness itself limits considerably the scope for applying modern techniques, yet, as a means to promote economic growth there is no alternative to planning in these countries. The crucial problem is to achieve a high rate of growth in a relatively short period of time, and that with the very limited resources at their disposal. This necessitates the careful utilisation of resources, streamlining the processes of production, effecting the necessary social and attitudinal changes and devising of means by which the investible surplus in the economy can be steadily augmented. This clearly, is the essence of planning for development. The fact that sophisticated techniques cannot be put into use immediately need not be a deterrent in this direction, for, in the very process of planning and development, the required facilities will be created.

CHAPTER 2

The Approach to Planning

Economic backwardness implies social backwardness as well. The problem of the third world countries like India is not merely low per capita income and poverty but also the concomitant social evils of ill health, low standard of literacy and exploitation of the weaker classes by the rich. Therefore the approach to planning in these countries has to be different from that in advanced countries in the sense that special attention has to be devoted to the removal of the social evils. In particular, the development models of the under-developed countries should take into account the following points:

(1) Greater importance should be attached to real income growth than money income growth. Real income should include improvement in social conditions also, i.e., development of education, health facilities, betterment of social relations, etc.

(2) There is great need for combining development with social justice. In our enthusiasm for social justice and uplift of the masses it is unwise to decry growth or consider it as irrelevant or unnecessary. In fact, economic growth and better distribution of wealth and social justice are not competitive ideals but complementary to one another.

(3) Planning should be along democratic lines. The ideal way of achieving this is to start planning at the village level where the experienced, well informed and the senior members of the village may be taken into confidence in drawing up programmes of development for the village. At a higher level there should be a district plan based on the village plans. The

district plans in turn would form the basis of the state level plans, and the national plan should be an integration of all the state plans. This is the reverse of what is happening in India today. The present system in India is to plan from the top, fix the outlays for the major projects and also the financial size of the plan for each state. The states are then required to fit in their programmes within the limits set by the Union Planning Commission.

(4) Stress should be laid on the proper utilisation of resources and endowments. In under-developed countries planning should aim at making the best use of the countries' natural advantages—water resources, forest wealth, minerals, export markets, etc. Thus in one under-developed country planning may be export oriented; in another, planning would aim at building up the economy by developing its forest wealth, or its agricultural resources.

(5) This does not mean that industrial development should be ignored. But what should be given up is the craze for raising per capita money income through industrialisation. Planning should serve the purpose of building up human society along sound lines. The goal of economic development should be not merely the achievement of material progress and a rise in per capita GNP but also improvement of social welfare, eradication of poverty, and better living conditions for all classes of people. Particularly in the matter of rural development it is necessary to think out ways of transforming the villages into model areas combining growth with justice. If some at least of these ideals are translated into practice, it would be possible to evolve a pattern of development truly distinctive of India and which may well be a real contribution to world economy.

An equally important point to consider in this connection is the relevance of sophisticated techniques of planning to the low income countries. The reason why these techniques cannot be made use of in economically backward countries in the manner and to the extent they have been made use of in the advanced countries has been explained earlier. But this does not mean that so far as planning in under-developed countries is concerned, these modern techniques have to be given the go-by and that an altogether different set of techniques has to be evolved for the purpose. This is not necessary for the simple reason that with all the differences in administrative and institutional set up and in natural endowment, the essential nature of planning is the same in both groups of countries. Given this, what has to be done is to adapt the modern techniques of planning in such a way as to suit the requirements and socio-economic features of the poorer countries.

The basic objective in national economic planning is to utilise the resources in such a way as to maximise the benefit to the total economy. Obviously, the techniques of allocating and using the resources and the means at the disposal of the governments for implementing the schemes differ according to the ideology and institutional set up of the country concerned, but the fundamental objectives and principles involved are the same. In a country which is economically and socially backward, planning involves taking into account a number of qualitative factors, the evaluation and analysis of which presents serious problems. Yet to the extent the basic consideration is optimum utilisation of resources, the accepted techniques of planning should be applicable to a variety of cases. But even the most sophisticated techniques will have to be tested for their applicability in the low income countries modified when necessary and adapted for the purpose in hand.

Elementary Techniques

The first step in planning is to lay down a few clear-cut and realistic objectives;—an increase in national and per capita incomes, creating greater employment opportunities, rapid industrialisation of the country or expansion of the agricultural sector or social or socialistic objectives, such as the improvement of the health and educational standards of the people, better distribution of wealth and income, eradication of poverty, etc. But whatever be the objectives, they are clearly to be defined to the extent possible, and the targets are to be fixed in quantitative terms. Thus, in the matter of income, the objective may be doubling it in a given period of time, or raising it by a certain percentage. The target with regard to eradication of poverty or raising the standard of living may be expressed as ensuring average food consumption of a certain calorific value, or raisiag educational standards in terms of percentage of literates or improving health standards by increasing the average expectation of life or reducing the child mortality rates to a specified point.

When the objectives are defined and the targets fixed, the next thing to do is to estimate in a rough manner the investment required to attain the targets. The planning body should have a clear idea of the present resources position and the level which has been already reached in the area relating to the targets. In a low income country, the primary objective of planning for development may well be the raising of the per capita income. In fact, the attainment of the other objectives of a socio-economic nature are dependent on, and implied in, an increase in the State's national income and in the income per head. The present per capita income is known and if the target is that this is to be doubled, say, in a period of 15 or 20 years, one can easily arrive at the level which total income should reach at the end of the period by multiplying the expected population of the target year by double the per capita income of today. The difference between the aggregate income of that year and the aggregate income of the present year will indicate the extent to which national income should increase in the given period of 15 or 20 years. This figure multiplied by the capital-output ratio would give a rough idea of the magnitude of investment required. Thus, if the desired income increase is Rs.5,000 crores and the capital output ratio is 3:1, the investment required is Rs.15,000 crores.

An estimate like this would help in calculating the annual rate of growth of income and also the savings required. If the current level of national output is 1000 and the savings form 6 per cent of the output, an investment of 60 would result in an increase in output of 20 if the capital output ratio is 3:1. If population is increasing at 1.5 per cent per year, the gain in per capita income will be no more than 0.5 per cent a year. This means that, if the population growth rate remains constant at, say, 2.5 per cent, an annual increase of per capita income of 1 per cent can be achieved only by raising savings and investment from the existing level of 6 per cent of the national output to 10.5 per cent [$10.5 \div 3 = 3.5$]. If savings cannot be raised to this extent, the only possibility of achieving a 3.5 per cent growth rate in income is to lower the capital-output ratio by resorting to investment schemes in which the returns would be relatively larger than in capital-intensive schemes. But, then, this is a choice depending on policy objectives-rapid industrialisation or expansion of the agricultural and small industries sector.

It is thus clear that, when once the targets with regard to income and the period in which the targets are to be reached are fixed,[1] the means that remain for stepping up the existing rate of growth will be limited to (a) finding out and making use of the optimal direction of investment; (b) raising the level of investment by raising the savings margin; (c) modifying the capital-output ratio or choosing those lines of investment which would secure the required growth rate with the investible resources available; (d) trying to secure more foreign aid; and (e) so regulating the private sector that it contributes the maximum possible to national output.

Sectoral Planning

An economy is divided into different sectors; the consumption goods sector and the investment goods sector; the export sector and the home market sector; the farm sector and industrial sector, etc. However, from the administrative point of view, it would be advantageous to define the sectors in a more detailed manner on a functional basis. It is easy to identify about half a dozen large aggregations such as agriculture, manufacturing industries, small industries, economic overheads and social services or the tertiary sector. The problem is to formulate programmes of development for these sectors which would help in filling in the details and refining the aggregate plan.

It is important that the investment outlays envisaged by the different sectors should add up to the total for the economy and that the targets of growth fixed for the sectors fit into the overall rate of growth. When the aggregate income to be reached in the target year is determined, it would be possible to estimate a certain reasonable rate of growth per year. When this rate is determined, the total income for each year in the plan period can be calculated; and this has to be apportioned among the sectors. The proportionate contribution of each sector to the total income in the base year is known. In the first year, agriculture may account for, say, 50 per cent and industries 15 per cent. In a dynamic economy, this ratio changes over a period of time in the normal course of economic development, but in a planned economy, this change may be deliberately brought about. Thus, over a 15-year period, agriculture's contribution may be expected to decline to 30 per cent and that of the industrial sector to rise to 25 or 30 per cent. Similarly, relative changes may be envisaged for the other sectors also. These proportions for each 5-year period may be fixed in an arbitrary way. It is then easy to calculate the extent to which income generated in each sector is to rise, by the end of each 5-year period. The desired income increase in a particular sector in a given time period multiplied by the capital co-efficient of that sector gives the investment required over that period of time in that sector. The sums of sectoral investments calculated for each year will be the total investments required for that year.

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[1] It may be easily seen that, if the target date is put off by, say, five years, the annual growth rate required will be less, and therefore investment requirements will also be less.

Meshing Sectoral Plans with the Aggregate Plan

Since planning for the economy is done at the government level, and the various departments of the government are responsible for the efficient implementation of the plan schemes, proper co-ordination between the two agencies becomes all the more important. In other words, the plan drafted by the Government or the Central Agency should be the result of an integration of the sectoral schemes. How is this co-ordination and integration brought about?

The Central Planning Agency would fix tentatively the overall objectives, targets and outlays for the sectors, and the sectors would draw up project proposals, within this broad framework.

These would be reviewed by the former, modifications might be suggested and the proposals would be referred back to the sectoral agencies and so on; the process would continue until the sectoral programmes are fitted in properly into the aggregate plan. The central exercise would consist in fixing the objectives as well as the time-period within which they are to be achieved, estimating the savings, available in the economy and the potential savings, an assessment of the sources of savings, the growth of population, and a tentative allocation of resources among the sectors. At this stage, it is obviously impossible to estimate the optimum allocation of resources among the sectors. The projects competing for funds will be so great in number that the judgement of informed and experienced administrators and disinterested individuals will be the best guide for apportioning the funds. The only important quantitative guide to the plan's sectoral allocations at this point is the current level of expenditure in each sector. At a later stage, revisions would have to be made upwards or downwards in the light of recommendations and suggestions from the sectoral agencies.

When the central proposals are sent to the authorities for sectoral planning the latter have to fill in the details and make concrete proposals for development. Work at this level involves:

(1) the sketching of a development model for each sector;

(2) the setting of production targets in fairly specific terms;

(3) the generation of specific projects and programmes;

(4) a cost analysis of the programmes; and

(5) the specification of a policy framework and the administrative means to implement the proposals.

In determining the feasibility of the programmes drawn up by the sectors not only technological factors but economic implications also are to be taken into account. Here a crucial role is played by relative prices, the movement of which (actual or assumed) would reflect supply and demand conditions. The projects have to be evaluated on the basis of a cost benefit analysis. But how to estimate costs and benefits? To begin with, the existing level of prices may be taken as the base and the cost of the project can be calculated more or less correctly. If a demand forecast of the output of the project is also made, it would be possible to say whether the assumed price will be an equilibrium one. Any excess of demand would indicate a rise in prices. Thus, if the existing prices are known, shadow prices can be assigned to any product according to its prospective relative scarcity or excess. The discrepancy can be set aright by repeated revision and modification of the proposals until finally an equilibrium position is arrived at. This is usually called the iterative process but the term is only an euphemism for the simple trial-and-error method.

What has been indicated above are the lines along which planning is to proceed if there is to be proper co-ordination of the sectoral programmes and proper integration of these schemes in an overall plan. The basic requisite of a workable plan is the consistency between the sectors on the one hand and between the sectoral programmes and the central plan on the other. In particular, this sort of consistency has four aspects. In the first place, it is clear that there must be a proper balancing of the financial resources and the total plan outlay. Financial resources here would mean all the resources available, from whatever source, to meet the expenditure. If domestic savings are inadequate and a gap develops, provision has to be made to close this by external aid or deficit financing. Secondly, there should be a basic conformity between sectoral and overall objectives. Sectoral programmes should be of such a nature as to contribute to the attainment of the overall objectives. If the overall obiectives are full employment or increased foreign exchange earnings or a rapid growth in incomes, the sectors should be able to show that their programmes serve this end. Thirdly, there should be a balance of inputs and outputs. The development of one industry needs more power, transport facilities, etc., which are to be supplied by other sectors. Hence any programme for the expansion of the first should indicate the extent to which the latter are also to be expanded. This calls for an analysis of the demand and supply of the commodities and for the establishment of physical balance-sheets. Thus, if the economy is divided into two broad sectors—the consumption goods sector and investment goods sector—the sum of the

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net outputs of both sectors must equal national income according to the consumption-income ratio. If the consumption-income ratio is 0.8:1, then the ratio of output of the consumption and investment goods sectors must be 0. 8:0.2 or 4:1. Lastly, there is to be a balance between foreign exchange resources and expenditures. This is of special significance in a developing economy which, in the initial stages of industrialisation, has to depend on foreign countries for its investment goods. The financial requirements of a development programme may be divided into domestic currency and foreign exchange requirements. The foreign exchange requirements of the sectors should be equal to the total foreign exchange earnings of the economy.

Considering the limitations of the administrative machinery in an under-developed country, the method of economic planning outlined above may be deemed to be adequate and feasible. But it certainly falls short of an ideal system. One obvious defect is that it is so time-consuming. The efficiency of it depends on the attention to details given at the two ends—the central planning authority on the one hand, and the different sectors on the other—and also the promptness with which checking, cross-checking and revision can be done. Secondly—and this is more important—the planners would be concentrating mostly on the problems in hand and would be drawing up their programmes on the basis of the data available currently. Needless to say, over the plan period extending over 5 or 10 years, very important changes—technological, institutional and attitudinal—may take place which can certainly not be fully envisaged by the planners.* Moreover, the basic objective of planning is to bring about dynamic changes in the economy according to a

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*For this reason it is meaningless to encumber a long-term plan, usually called a perspective plan with unnecessary details. "Unlike medium-term plans, long-term plans do not include comprehensive programmes specifying sets of concrete projects together with time schedules for their implementation. They aim at the identification of the main problems that will become apparent in the future and deciding before hand what strategies should be chosen now in order to prepare the respective sectors of the economy for the future solution of these problems." Krzysztof Porwit—"Perspective Planning in Poland: Basic Issues and Experiences", *Journal of Development Planning*, No. 3/29, United Nations, New York, 1971.

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desired pattern. None of these desired changes can be looked at in an isolated manner, regardless of what is happening to the other sectors. The implication of such interdependent changes cannot be foreseen, and to that extent, the plan would be unrealistic and would create problems in implementation.

These limitations underline the need for examining the scope for the application of some of the well-known techniques of planning to developing economies.

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CHAPTER 3

Modern Techniques: Econometric Model

There are a few well tested modern techniques of planning which have been made use of with success in the economically advanced countries. These techniques are essentially of a quantitative nature and are suited to the drawing up of designs of development when the objectives are well defined, and the economic variables that determine development can be expressed in quantitative terms. In under-developed countries some of the factors that vitally affect economic progress are of a qualitative nature which are not easily amenable to quantitative treatment. Nevertheless, there are vast areas of activity such as industrial and agricultural production and the growth of the services sector as well as income and population growth where quantitative assessment and analysis are possible. Hence even in the low income countries it is worthwhile making use of sophisticated techniques to the extent possible. Obviously, suitable adaptation of these techniques is necessary, but the nature of the adaptation that has to be made can be known only in the process of application of the techniques.

Whatever be the standard of development of a country and whatever its political ideals and faith, a plan for its economic development has to conform to some basic requirements; firstly, the plan is to be feasible; secondly, it should be a scheme for the utilisation of resources in an optimal manner and thirdly, the sectoral plans on which the overall plan is based should be consistent with each other. Feasibility of a plan can be tested by an econometric model; optimisation is possible with the help of linear programming; and the consistency of a plan can be checked up by an input-output model or by preparing a commodity balance account. In this and in the following two chapters, these three techniques in their elementary form are explained with a view to focus attention on their salient features and to bring out the scope for their adoption in under-developed countries.

Plan Feasibility: Econometric Model

A plan is said to be feasible if its tragets are achievable with the given resource availabilities and production structure. That is to say, feasibility depends not only on the amount of resources available but also on the manner in which these resources are utilized. The existing resources can be put to greater use by utilizing each resource to the maximum extent possible—for example in a factory, by introducing an additional shift, a larger number of workers are employed with the same stock of capital, thereby reducing the capital-output ratio. By offering better incentives to labour and by streamlining the operational methods labour can be made to work over a longer period of time or more efficiently in the existing period of time. Either way, output per head of labour is increased. Improvement along these lines would also imply that the national resources are put to greater use.

A feasible plan should ensure that given the targeted income and the capital-output ratio, the rate of growth of capital should be such as to make the target achievable. The rate of growth of capital depends on the rate of growth of savings which in turn is determined by the difference between the rate of growth of income and rate of growth of population (per capita income increase) and the pattern of income distribution. Apart from income increase, the objectives may well be to reduce substantially the level of unemployment and/or better distribution of income and wealth. And since the volume of employment depends on the availability of capital it follows that, given the population growth rate and increase in labour force, investment or growth of capital should be in step with the former. Also, if income redistribution is another objective, it should be such as to reduce inequality without affecting savings. Any gap in financial resources is usually closed by foreign borrowing or deficit financing. In either case the disturbing effect of such a measure on the internal or external balance of the economy should be taken into account and controlled.

Ascertaining feasibility with the help of an econometric model

Given the targets of growth—development of the different sectors of the economy, growth of income, employment, distribution pattern, etc.,—it is possible to find out with the help of an econometric model whether the available resources would be adequate to achieve the targets.

There are some basic activities in an economy which are interrelated. Some of these are investment, savings, government spendings, exports, imports, employment, distribution of aggregate income, etc. The inter-relationships between these variables are stated and explained in economic theory. Econometrics verifies this explanation and expresses the relationship in quantitative terms. For instance theory says that at any time consumption of an economy forms a certain proportion of income (average propensity to consume) and that as income increases, consumption also increases but less than proportionately (marginal propensity to consume). This statement may be verified by taking statistical data relating to income of a group of families or of a country over a series of years and the consumption outlay in these years. It would be found that on the average, consumption forms 80 per cent of the income. And the theoretical statement may be expressed quantitatively as $C = 0.8Y$ where C is consumption and Y is income. The expression of the theory in a quantitative form is an econometric statement.

In actual fact the relationship and interdependence between economic activities is much more complicated. Any one activity such as investment would influence other important activities and would in turn be affected by them. An econometic model is the statement of this relationship in the form of equations. A simple model of the United States economy prepared by the

American econometrician L.R. Klein* may be used for purposes of illustration. In his model the consumption equation is

$$C = 16.8 + 0.02P + 0.23\,P_{-1} + 0.80\,(W_1 + W_2) \qquad (1)$$

Where C is consumption, P profits of the current year, P_{-1} profits of the previous year, W_1 wages in the private sector and W_2 wages in the public sector. The co-efficients express the quantitative relationship. The equation says that consumption in a particular year is related to profits of the current year, profits of the previous year and wages in both the private and public sectors.

Similarly,

$$I = 17.8 + 0.23P + 0.55P_{-1} - 0.15\,K_{-1} \qquad (2)$$

I is investment, K_{-1} is capital stock in the previous year. The minus sign before the numerical co-effieient in the last term indicates that I is a decreasing function of the capital stock in the previous year.

$$W_1 = 1.6 + 0.42X + 0.16X_{-1} + 0.13\,(t{=}1931) \qquad (3)$$

W_1 denotes wages in the private sector, X is output, X_{-1} output of the previous year and 't' stands for time measured in calendar years.

These three equations are called the behavioural equations and describe the behaviour of the groups of people engaged in different economic activities—investors, entrepreneurs, government, households, wage earners, etc. In addition, there are three other equations which are accounting identities that must be true by definition. These are called definitional equations.

$$X = C + I + G \qquad (4)$$
$$P = X - W_1 - T \qquad (5)$$
$$K = K_{-1} + I \qquad (6)$$

G is government expenditure and T business taxes. How would a model like this help in economic planning? Obviously, since the equations describe the manner in which one activity depends or reacts on another, and since this relationship is shown in quantitative terms, it would be possible to forecast the effect of a change in one activity on the other by solving the equation or equations for any one required variable. The variables incorporated in the model are divisible into two, exogenous variables and endogenous variables. The former represents those activities which are independent of the economic process depicted in the model. The values of exogenous variables are determined independently of, and outside the model, whereas endogenous variables are those whose values are determined by the model. For instance, investment by government, taxation, exports are independently determined and are exogenous. But consumption is determined by income which in turn is determined by investment and consumption.

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*Theil, Henri, 'Operations Research and Quantative Economics, (International students edition, Kogakusha Company Ltd. Tokyo 1965) pp. 77-86.

Some of the exogenous variables can be altered independently of the economic process and hence they serve as policy instruments. Since exogenous and endogenous variables are interconnected, the government or the planning body can, by operating on these variables influence the behaviour of the economy. But in order to do this, it is necessary to know as accurately as possible, the effect of an initial change of the exogenous variables and the various interactions which it sets in motion. The method used here is to solve the system of equations in the model by first expressing all endogenous variables as functions of the exogenous variables. This can be illustrated by a simple example:

Suppose we have two equations $C=0.8Y$ and $Y=C+I$. We know from this that income is the sum of consumption and investment and consumption is 80 per cent of income. If investment is treated as exogenous, and is therefore a policy variable, it should be possible to know the effect of an increase or decrease in I on income. For this the equation is changed to its reduced form in which Y is expressed as the effect of a given value of I. We substitute the consumption function $C = 0.8Y$ into the equation $Y = C + I$ to get

$Y = 0.8Y + I$ or $0.2Y = I$

Thus $Y = 5I$

This is an extremely simple form but it brings out clearly the principle underlying it.

For planning purposes a large model consisting of 20, 30 or more equations is made use of. The larger the number of equations, the more detailed and exhaustive is the model. The econometric model is therefore a detailed statement of an economy expressing the inter-relationship between fundamental variables and their behaviour in the form of equations. Each equation states how a particular variable is affected by several other variables. The solution of a series of simultaneous equations shows how if decision is taken regarding the size or magnitude of the policy variables like, taxation, subsidies, distribution pattern, investment, export promotion and the like, the other variables such as income, consumption, employment, savings, imports, etc., will change. It should be remembered that there is no hard and fast line of distinction between exogenous and endogenous variables. What is endogenous in one set of equations may be treated as exogenous in another set. Thus, the government or the Planning body will know how raising the level of taxation or increasing exports by means of subsidies, will bring about changes in employment, income, savings, growth of particular industries, etc., and to what extent. Alternatively, given the objectives of the government, it may fix targets (relating to income growth, employment, etc.) and design policy measures which would achieve the objectives.

The practical value of an econometric model, its limitations and the problems involved in its construction can be illustrated with reference to the economy of any Indian state. In the first place, the major objectives of planned development are to be spelt out. These may be increase in income at a certain annual rate so that at the end of a period of time—say 10 or 15 years—the State's income as well as per capita income will reach an expected target level. Secondly, given the objective, the means of attaining this end are to be defined. Here the policy variables are to be indentified and a decision to be taken with regard to the operation and handling of these variables. Thirdly, given the inter-relationship between these variables it would be necessary to visualise in advance how changes in these variables would act and react upon one another. For example, it is important to foresee how income would change with a given increase in investment, how it would affect the pattern of distribution, to what extent government's revenue collection would go up, what will be the effect on public borrowing, private investment, etc., and how income growth would influence employment situation and the number of people below poverty line or necessitate increased public expenditure on education, public health, social services and so on. However, bearing in mind the constraints usually met with in a developing economy the components of the model are to be restricted to a few more important variables and the model itself is to be designed to provide answers to certain basic issues.

To begin with, the variables are to be defined and classified as follows:

(i) *Endogenous Variables*

(1) Y — Aggregate income
(2) Y^{pe} — Private consumption expenditure
(3) Y^{pd} — Private disposable income
(4) I^{s} — Investment by the state
(5) I^{p} — Private investment
(6) C — Total consumption expenditure
(7) W — Wage income
(8) R^{a} — Income of the agricultural sector
(9) Y^{g} — Government's income

(ii) *Exogenous Variables*

(1) I^{c} — Direct Central investment
(2) A^{c} — Assistance from Central Government
(3) T^{r} — Tax revenue
(4) NT^{r}— Non-tax revenue
(5) P^{b} — Private contribution to State Government
(6) Y^{cc} — Government's current expenditure
(7) G^{es} — Government's expenditure on social services
(8) G^{de} — Government's development expenditure
(9) T^{c} — Total tax collections

The equations made use of in the model may be grouped into definitional equations and structural equations.

(a) *Definitional Equations*

Aggregate state income is defined as the sum of current consumption expenditure and investment expenditure. The former is broken down into Government's consumption expenditure and private consumption expenditure. Total investment is the aggregate of state investment which includes assistance from the Central Government, private investment and investment made directly by the Central Government:

$$Y_t = Y_t^{ce} + Y_t^{pe} + I_t^{s} + I_t^{p} + I_t^{c} \tag{1}$$

'*t*' is the time subscript.

State investment is equal to the difference between all state collections inside the state by way of tax and non-tax revenues and public borrowing plus Central assistance on the one hand, and Government's current expenditure on the other.

$$I_t^{s} = T_t^{r} + NT_t^{r} + P_t^{b} + A_t^{c} - Y_t^{ce} \tag{2}$$

Private investment is the difference between private disposable income and private consumption expenditure.

$$I_t^{p} = Y_t^{pd} - Y_t^{pe} \tag{3}$$

Total consumption is the sum of private consumption and government consumption. The latter is made up of (a) government's current expenditure, and (b) government's expenditure on development services and on social services. A division like this is made in order to estimate the effect of government's expenditure on social services (which comprise social welfare measures) on the poorer sections of the community.

$$C_t = Y_t^{ce} + G_t^{es} + G_t^{de} + Y_t^{pe} \tag{4}$$

Private disposable income is defined as the state's income minus all collections by the state. Strictly speaking, disposable income is aggregate income plus transfer payments less all types of taxes. But, transfer payments are quite negligible in a low income country and as such, disposable income for the present purpose is defined as state income minus all taxes, state and Central, and other government receipts including internal borrowing.

$$Y_t^{pd} = Y_t - T_t^r - NT_t^r - P_t^b \qquad (5)$$

State government's income is made up of tax revenue, non-tax revenue, borrowing from the public and Central assistance,

i.e., $Y_t^g = T_t^r + NT_t^r + P_t^b + A_t^c$ (5a)

(b) *Structural Equations*

Structural equations bring out the relationship between certain fundamental variables, and present one set of variables as functions of another set. **Thus,**

$$Y_t^{ce} = d_1 + d_2\, Y_t^g \qquad (6)$$
$$Y_t^{pe} = d_3 + d_4\, Y_t^{pd} \qquad (7)$$
$$W_t = d_5 + d_6 Y_t + d_7 R_t^a \qquad (8)$$

d_1, d_3 and d_5 are constants and d_2, d_4, d_6 and d_7 are parameters.

These equations mean (1) that government's current expenditure (Y_t^{ce}) depends on government's income (Y_t^g); (2) Y_t^{pe} or private consumption expenditure depends on private disposable income (Y_t^{pd}); (3) W_t or wage income is assumed to be influenced by aggregate income as well as income of the agricultural sector—the latter assumption being in consideration of the fact that agricultural income accounts for nearly half the aggregate income, and employment in the agricultural sector forms three-fourths of the total employment in the states. These three equations are given for illustrative purposes only. In reality, if the relationship and interdependence between all important economic activities is to be brought out, the number of structural equations will have to be correspondingly larger.

(c) *Estimating the Equations*

An equation with algebraic symbols for variables states the relationship between the variables in a general way. The parameters of the relationship are estimated by the appropriate method of regression. For example,

$Y_t^{ce} = d_1 + d_2 Y_t^g$ is a statement, in a general form indicating that government's current expenditure is determined by government's income. To what extent the former is influenced by the latter is known when d_1 and d_2 are given numerical values. Thus the estimated equation

$$Y_t^{ce} = -17572.2867 + 1.31623\ Y_t^{g}$$

gives Y_t^{ce} when the value of Y_t^{g} is given.

For estimating the equations, data for the preceding years with deflated prices are used. Econometric theory prescribes the appropriate methods of estimating structural equations. Application of the method of ordinary least squares gives in general, inconsistent estimates for the parameters of the structural equations. Consistent estimates can be obtained by the use of the appropriate econometric method such as indirect least squares, two stage least squares, etc. Such complications do not arise in the estimation of parameters of the reduced form because the reduced form expresses the current endogenous variables in terms of the predetermined variables (exogenous and lagged endogenous variables) which are uncorrelated with the stochastic disturbances of the structural equations.

As indicated earlier an econometric model may be restricted to a few basic determinants of economic activity—in which case there will be only four or five equations—or it may be a more elaborate model consisting of a much larger number of equations bringing out the mutual relationship and interdependence between several variables. In either case, the purpose is to forecast the effect of changes in the policy instruments on the endogenous variables. In order to achieve this end the simultaneous equations are to be transformed into the reduced form and then estimated.

An Assessment

The practical value of this exercise consists in the fact that the equations arrived at in the manner mentioned above can be made use of for estimating the future trends of some of the more relevant economic variables. This is done by substituting estimated future values of exogenous variables in the equations. Assumed or targeted values can be given to exogenous variables such as tax revenue, assistance from Central Government, government expenditure on social services, government's development expenditure, etc., and by inserting these values in the equations the resulting variation in the endogenous variables such as aggregate income, private consumption expenditure and government's current expenditure, private and state investment, as well as the pattern of distribution of income can be found.

However, the limitations of this method particularly in a developing economy have to be clearly borne in mind. First, it should be remembered that this is a quantitative method. It is difficult or impossible to incorporate qualitative factors like administrative efficiency, social attitudes of the people, the influence of custom and tradition and institutional factors in a mathematical model. Nevertheless, these factors are important and have considerable influence on the effectiveness or otherwise of policy measures intended to achieve definite objectives. To some extent, by making the model more and more elaborate and detailed, the influence of even minor determining factors can be gauged, but the results may not be worth the costs. Secondly, the econometric model like other sophisticated methods of planning is not likely to work satisfcatorily in a country which is predominantly agricultural and where large areas of economic activity remain tradition bound and not governed by commercial and business considerations. Even in an industrial economy to the extent it is of a mixed type with a relatively large private sector, comprehensive and reliable empirical information relating to a great part of the state's economic activities may not be forthcoming and for this reason accurate forecasting becomes difficult. These difficulties are compounded further in a developing country in which the private and public sectors co-exist.

Yet with all these limitations it is of advantage, and indeed necessary, to make a beginning in the use of this scientific method to the extent possible. Even in a developing economy, there are sectors influenced by modern business and commercial practices in which it would be worth-while to try to introduce quantitative planning techniques. As the economy progresses and gets transformed, the scope for the use of scientific tools and techniques of planning will widen, providing facilities for the refinement and adaptation of the methods in a manner relevant to the needs.

CHAPTER 4

Optimisation: Linear Programming

An econometric model helps to project the trend in the important variables of an economy into the future and to find out whether the objectives envisaged in the plan are attainable. In other words, it enables the planning authority to judge the feasibility of the plan and the plan targets. But apart from feasibility, there are certain other aspects of planning which have also to be taken into account. One of these is optimisation of the plan and the other relates to its consistency,

Optimality Planning

The resources of any sector of the economy as well as of the country as a whole are limited in relation to the need for the resources. In this sense the resources of even a very rich country are limited—limited relatively. In respect of any project or industry the need may be in the form of raw materials, labour and other inputs or financial resources which in general represent all the inputs. The supply of these may not be as much as required. Given these constraints, the planner who is concerned with the drafting of a programme of activity will have to think of reducing the demand for one resource or another or substituting one by another so as to make each unit of the resources go as far as possible in the attainment of the targets. This is true of planning for the economy as a whole as well, because here again, the targets of income growth or employment or exports can be reached only by making the best use of the limited resources.

The problem is therefore one of optimisation—or putting to use the inputs in the best or optimal way. Alternatively, it means an attempt to maximise the results from a given set of resources or minimising the cost involved in the use of the resources in order to attain the objectives.

Linear Programming

The mathematical technique ideally suited to solve the optimisation problem is what is called Linear Programming. Consider a programme for the development of the transport sector. The projects under the programme would comprise roads of different length, width and surface standards, railways, bridges, byways, etc. All the projects cannot be taken up because of limitations of finance, technical skill, materials and other resources. Given these limitations, the problem is to choose between the projects in such a way that the utilisation of resources is within the limits of availability and yet the resources are used in an optimal way. It is possible that when an allocation is made in this manner, a particular project may not be able to utilise some of the resources available to it because the combination of the factors is fixed on technological considerations. But from the overall point of view, the allocation of resources among the projects would have been done most efficiently.

A linear programming problem has the following elements:

(a) the objective function, i.e., the function whose value is to be maximised or minimised, e.g., profits or costs;

(b) the capacity constraints, the constraints represent the outer limit, e.g., total outlay possible, total employment or machine time or storehouse capacity available. These are the 'side conditions' and the optimal solution is to be found within the limits set by these side conditions. It is possible that in one line of activity, a particular capacity, say, machines or storehouse capacity, may be utilised in full but in another or others not. Hence the side conditions are inequalities rather than equations; and

(c) the non-negativity conditions of the variables: output or the supply of any factor should not be negative or less than zero.

The problem is called linear because the variables and the expression to be maximised are all related in a linear way. The relationship is assumed to be constant, and hence the inequalities involve only the variables multiplied by constants and added together. Thus if 10 labourers and materials worth Rs.10,000 are needed to turn out final commodities worth Rs.20,000, 20 labourers and materials of Rs.20,000 would produce exactly twice as much.

The linear programming problem and its solution may be illustrated diagrammatically. Assume the production of 2 goods by two processes—process A and process B. Each unit made with process A requires one unit of labour and each unit made with process B requires two units of labour. The total number of labourers available is 80. Similarly, process A requires 3 units of capital for each unit of output and process B requires 1 unit of capital for each unit produced. Total capital available is 90. The labour and capital constraints can be expressed as

$A + 2B \leqslant 80$ (labour constraint)
$3A + B \leqslant 90$ (capital constraint)

Assume also that each unit produced by process A brings in a profit of Rs.100 and each unit produced by process B brings in Rs.150. The total profit Z could be shown by the function $Z=100A+150B$. According to these assumptions maximising production implies maximising profits as well. The graphical solution of this model is given by Fig. 1.

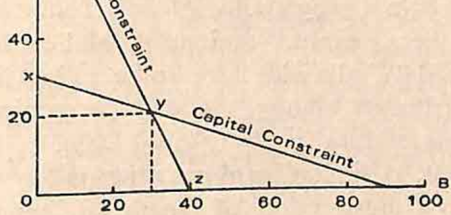

Fig. 1

$$A + 2B = 80$$
and $$3A + B = 90$$

The two equations can then be solved giving $A = 20$ and $B = 30$. According to the first equation if A is zero B is 40 and if B is zero A is 80. According to the second equation if A is zero B is 90 and if B is zero A is 30. The two lines indicating labour constraint and capital constraint are based on these values. Given the constraints fixed by availability of labour and capital, we have to find the optimum combination of outputs. The area within the two constraints and bounded by A and B is called the feasible region. The non-negativity condition requires that the optimum point should be above and/or to the right of 0. This region is marked *OXYZ* in the diagram. The optimum point where A and B intersect is point Y. At this point maximum production level is reached by making 20 units with process A and 30 units with process B. And profit is also maximum at this point and is given by $(20 \times 100 \text{ Rs.}) + (30 \times 150 \text{ Rs.}) =$ Rs.6,500.

The problem explained and solved above by means of the diagram may be stated in algebraic terms as:

$$\text{Maximise } Z = 100A + 150B$$

$$\text{Subject to the constraints } \begin{aligned} A + 2B &\leqslant 80 \\ 3A + B &\leq 90 \\ A &\geqslant 0 \\ B &\geqslant 0 \end{aligned}$$

But the actual problems that one has to face in economic planning are far more complicated. The inequalities and constraints would be many and the variables involved would be much larger in number. Consider, for example planning hydro-electric projects in a programme of power development. The matrrial resources, capital equipment, skilled labour, other imported materials, all will have to be utilised in an optimal way, i.e., distributed among the different projects in such a manner that maximum power supply is made available at a given total cost. A similar problem arises in the case of transport planning—construction of roads to connect different points in a rural area. Optimum cropping pattern in particular regions may be arrived at by means of linear programming. In all these, the technique employed is the same; and its general form will be as follows:

Suppose there are *n* industries with firms $X_1, X_2 \ldots X_n$; the value of the average output per given period of time of the firms is $C_1, C_2 \ldots C_n$. The objective is to maximise output, i.e.,

$$\text{Max}\,[f(X_1 \ldots X_n) = C_1X_1 + C_2X_2 + \ldots C_nX_n)]$$

Obviously, if the size of the firms is increased, output can be increased indefinitely. This is however, not possible because expansion of size is limited by the maximum amount of capital, labour, etc., available. Let $a_1 \ldots a_n$ be the various factors required and $b_1 \ldots b_n$ be the upper limit to the availability of the factors $a_1 \ldots a_n$. Maximisation of the output of all the firms must take place within the above constraints. That is to say,

$$\text{Max}\,[f(X_1 \ldots X_n) = C_1X_1 + C_2X_2 + \ldots C_nX_n)]$$

subject to the point $(X_1 \ldots X_n)$ being in some permissible or feasible set *K* which is specified by a system of linear inequalities in the form

$$\begin{array}{lcl}
a_{11}X_1 + a_{12}X_2 + \ldots a_{1n}X_n & \leqslant & b_1 \\
a_{21}X_1 + a_{22}X_2 + \ldots a_{2n}X_n & \leqslant & b_2 \\
\cdot \qquad \cdot \qquad \cdot & & \cdot \\
\cdot \qquad \cdot \qquad \cdot & & \cdot \\
\cdot \qquad \cdot \qquad \cdot & & \cdot \\
a_{m1}X_1 + a_{m2}X_2 + \ldots a_{mn}X_n & \leqslant & b_m \\
X_1 \geqslant 0, X_2 \geqslant 0 \quad \ldots X_n & \geqslant & 0
\end{array}$$

(*aij* is the product of the average output of the industry and its technical co-efficient).

The inequality in the last line rules out negative output. It can be easily seen that linear programming is ideally suited to development planning in so far as it involves an optimisation problem in respect of various industries or other economic units within the national economy. The objective function may be maximising output, or the number of people employed, or minimising costs, and the constraints may be the total investment outlay envisaged by the planning authority, labour supply or the land and natural resources available, transport facilities, etc.

Any set of values $X_1^0 \ldots X_n^0$, which satisfies all the inequalities is called a 'feasible solution'. The lower limit, of course, is zero output (but not negative output) and the 'optimal solution' is the one which specifies that combination of output which is the maximum possible within the constraints. Thus if a particular combination such as $C_1X^0 + C_2X_2^0 + \ldots + C_nX_n^0 \geqslant C_1X_1 + \ldots C_nX_n$ for all sets of $X_1 \ldots X_n$ values satisfying the restraints, then $X_1^0 \ldots X_n^0$ is called an 'Optimal solution'. The basic principle in arriving at an optimum is to start from a feasible point and proceed from one combination to another testing each for its effects on the objective function, leaving it out if it does not satisfy the requirement and finally reaching the optimum position.

Linear Programming is a versatile technique applicable to a variety of cases of economic activity in which the major problem is one of optimising the utilisation of limited resources. At the micro level it is widely made use of for purposes of planning the productive activity of firms, or as a parallel to this on the consumption side, the economic utilisation of resources in such a way as to ensure the achievement of maximum benefit or utility. At the macro level it is highly relevant to planning the development of a region or country by distributing limited financial resources among the various sectors of development. In general, the technique of linear programming will be found useful wherever there is a problem of choice between alternative means of achieving an objective and the existence of one or more constraints. What is important is to find out the proper method of presenting a problem making it suitable for the application of the programming technique. How this can be done is explained in the following example.

Consider a short-term development plan for a region or a country. Since drawing up and initiating the plan, some difficulty in implementing it is experienced because of unexpected events such as inflationary rise in prices or shortage of some basic materials because of external factors. Obviously, in such a situation the individual plans for the sectors cannot be carried through as originally envisaged, but the allocation of resources has to be revised or readjusted in the light of emerging constraints. Here the technique of linear programming can be made use of for carrying out the necessary adjustments.

The applicability of this technique can be illustrated with reference to the situation that developed in the state of Tamil Nadu as in the other Indian states as a result of inflationary condition in 1973-74. At the close of the year it was clear that the Plan for 1974-75 involving an outlay of about Rs.150 crores could not be carried through without modifications because of the rapid rise in the prices of certain basic industrial materials such as petrol, aviation spirit, chemicals used in the fertiliser industry, cement, steel and food articles. Besides, there was acute shortage of essential items like steel, coal, oil, power and fertilisers. Since this scarcity did not affect all sectors alike, it would be unwise to prune down the scale of investment outlays on the basis of this criterion alone. For this purpose, apart from the scarcity of inputs, other important factors would also have to be taken into consideration.

Because of the rise in prices the cost of the schemes in the annual plan would have gone up by about 20 per cent since the formulation and initial costing of the projects. This would mean that a plan of the size of Rs.150 crores, as drawn up in 1973-74 would involve a cost of about Rs.180 crores in 1974-75 because of the price factor alone. Conversely, if the outly is to be maintained at Rs.150 crores the physical targets were to be brought down by about 16 per cent.

The physical targets are the size of output of goods and services in respect of each sector. The investment outlays envisaged for the different sectors are closely related to the desired output of each sector, i.e., income generated in each sector. It follows that any alteration in the scale of outlay is bound to affect the scale of output. The sectoral outputs in turn have a close bearing on the overall growth of income.

Given the output targets, the higher costs of inputs and their scarcity, the problem is to refix the sectoral priorities or prune out a few projects so that the money cost remains the same (which means that in physical terms the quantity of inputs would be reduced) but the difference between the output as originally targeted and the actual output after the shifting of allocations is kept to the minimum.

The constraints, the objective function (i.e., maximising output) and the side conditions indicated above show clearly that this is a typical linear programming problem. Solution of the problem would help us to have a general idea of the relative effect of readjustment of investment outlays on the output of the different sectors. This in turn would provide a rational means of assigning priorities.

For purposes of planning, the economy is divided into six sectors—Agriculture, Large Industries, Power, Small Enterprises, Transport and Communications and Services. The target output is indicated in the plan drafted in 1973-74. Now, priorities among these sectors have to be refixed with reference to the extent to which the output of these sectors would fall short of the targets because of the shortage of basic inputs—coal, oil, power, cement, fertilisers and steel. It is, therefore, necessary to find out (a) the availability of these materials in 1974-75; (b) the physical output targets fixed for the different sectors; (c) the requirement of those inputs for each unit of output of these sectors.

The output targets for 1974-75 are estimated on the assumption that there will not be any scarcity of inputs. Given the technical co-efficients and the possible availability of basic inputs mentioned above (which will be less than or equal to what is originally assumed), the problem is to find out what the optimum output in each sector can be. Since the scarce materials are not required in equal proportions in each sector, the output possibility of the sectors will vary according to their need for scarce inputs. Despite the scarcity of inputs, the output of some sectors may not be very much affected while in others there is likely to be a serious shortfall. The sectors can, therefore, be re-arranged, giving priority to those whose productive activity will not be hampered to any appreciable extent. On the basis of this priority listing, it would be possible to suggest, the reducing, maintaining or raising of the investment outlays originally envisaged.

The Model

Symbols used

X_1 = Income of the Agricultural Sector for the year 1974-75 at 1970-71 prices.

X_2 = Income of the Industries Sector (Mining, Large Industries and Small Industries) for the year 1974-75 at 1970-71 prices.

X_3 = Income of the power sector for the year 1974-75 at 1970-71 prices.

X_4 = Income of the Transport and Communications Sector for the year 1974-75 at 1970-71 prices.

X_5 = Income of the Services Sector for the year 1974-75 at 1970-71 prices.

Shortage arises in the case of certain basic inputs. The availability of these materials is presented as follows:

S_1 = The likely available quantity of Coal in 1974-75
S_2 = The likely available quantity of Oil in 1974-75
S_3 = The likely available units of Power in 1974-75
S_4 = The likely available quantity of Cement in 1974-75
S_5 = The likely available quantity of Fertilisers in 1974-75
S_6 = The likely available quantity of Steel in 1974-75.

Technical Co-efficients

Items	*Sectors*				
	Agriculture	*Industries*	*Power*	*Transport and Communi-cations*	*Other Services*
Coal	a_{11}	a_{12}	a_{13}	a_{14}	a_{15}
Oil	a_{21}	a_{22}	a_{23}	a_{24}	a_{25}
Power	a_{31}	a_{32}	a_{33}	a_{34}	a_{35}
Cement	a_{41}	a_{42}	a_{43}	a_{44}	a_{45}
Fertilisers	a_{51}	a_{52}	a_{53}	a_{54}	a_{55}
Steel	a_{61}	a_{62}	a_{63}	a_{64}	a_{65}

aij is the quantity of the i^{th} input (in thousand tons)* required for generating one crore rupees of income in the j^{th} sector.

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*The technical co-efficients corresponding to power sector are in million units. For example, a_{32} is the quantity of power in million units required for generating one crore rupees of income.

Some co-efficients will evidently take zero values. The technical co-efficients, viz., a_{ij} $(i = 1, 2, \ldots 6)$ $(j = 1, 2, \ldots 5)$ have been calculated from the data relating to the use of the inputs in the year 1970-71 and the sectoral incomes (at 1970-71 prices) of the same year using the formula

$$a_{ij} = \frac{\text{Quantity of the } i^{th} \text{ item consumed in the } j^{th} \text{ sector in the year 1970-71}}{\text{Sectoral income of the } j^{th} \text{ sector of the year 1970-71 (Rs. in crores)}}$$

The sectoral income figures, as well as data relating to the inputs are obtained from various government reports and official publications.

A table of technical co-efficients calculated in the manner indicated above for 1974-75 is presented below:

Technical Co-efficients

Items	*Sectors*				
	Agriculture	*Industries (Large Industries+ Small Industries+ Mining)* 3	*Power* 4	*Transport and Commnnications* 5	*Other Services* 6
Coal	0.0000	4.3587	65.5203	0.0000	9.7369
Oil	0.0333	1.0552	0.0000	0.3866	2.7170
Power	1.3474	6.6785	0.0000	0.7060	0.4997
Cement	0.0000	0.0000	0.0000	1.2796	0.0000
Fertilisers	0.3214	0.0000	0.0000	0.0000	0.0000
Steel	0.0000	1.7058	0.0000	0.2075	0.0000

The likely available supply of the inputs in 1974-75 is shown in the following table:

Item	*Unit*	*Supply in 1974-75*
Coal	'000 tonnes	7924.0000
Oil	'000 tonnes	1393.4660
Power	Million units	7469.0000
Cement	'000 tonnes	1300.0630
Fertiliser	'000 tonnes	445.3000
Steel	'000 tonnes	1034.6000

The problem in hand is one of maximising the total output (objective function), viz., $X_1 + X_2 + X_3 + X_4 + X_5$ subject to the conditions (constraints) that the total requirements of scarce materials should be less than or equal to the total availability, i.e., we have to solve for X_1, X_2, X_3, X_4 and X_5 such that the solutions maximise the objective function $f(x)$. This is presented in matrix form below:

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} & a_{15} \\ a_{21} & a_{22} & a_{23} & a_{24} & a_{25} \\ a_{31} & a_{32} & a_{36} & a_{34} & a_{35} \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \\ a_{61} & a_{62} & a_{63} & a_{54} & a_{65} \end{pmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \\ X_5 \\ X_6 \end{bmatrix} < \begin{bmatrix} S_1 \\ S_2 \\ S_3 \\ S_4 \\ S_5 \\ S_6 \end{bmatrix}$$

i.e., $AX \leqslant S$; $S_1 \ldots S_6$ represent available supply of materials

Using the values of a_{ijs} and $S_1 \ldots S_6$, the problem to be solved is:

$$\begin{bmatrix} 0.0000 & 4.3587 & 65.5203 & 0.0000 & 9.7369 \\ 0.0333 & 1.0552 & 0.0000 & 0.3866 & 2.7170 \\ 1.3474 & 6.6785 & 0.0000 & 0.7060 & 0.4997 \\ 0.0000 & 0.0000 & 0.0000 & 1.2796 & 0.0000 \\ 0.3214 & 0.0000 & 0.0000 & 0.0000 & 0.0000 \\ 0.0000 & 1.7058 & 0.0000 & 0.2075 & 0.0000 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \\ X_5 \\ X_6 \end{bmatrix} \leqslant \begin{bmatrix} 7924.0000 \\ 1393.4660 \\ 7469.0000 \\ 1300.0630 \\ 445.3000 \\ 1034.6000 \end{bmatrix}$$

The solutions obtained are given below:

$$\begin{aligned} X_1 &= 1358.5009 \\ X_2 &= 482.9743 \\ X_3 &= 64.4582 \\ X_4 &= 1015.9917 \\ X_5 &= 163.7142 \\ \hline &\ 3085.6393 \end{aligned}$$

The above are the maximum possible sectoral output figures at 1970-71 prices based on the optimum utilisation of scarce materials.

Utilising the state outlay figures for 1974-75 and assuming that state sector outlay forms about 42 per cent (the remaining 58 per cent being accounted for by the Central Sector and the private sector), the total outlay for 1974-75 was calculated. This figure was converted into 1970-71 prices and then using the sectoral capital output ratios the state income that will be generated as a result of the outlays envisaged for the year 1974-75 was estimated. This figure was added to the state income for the year 1973-74 in order to get the income for the year 1974-75.

The state income figures for the year 1974-75 thus obtained is in 1970-71 prices. Assuming a 6 per cent increase in prices per annum, the income figure for 1974-75 (at current prices) was calculated. This total figure was allocated among the different sectors according to the sectoral structure as observed in 1970-71. The sectoral figures thus obtained may be compared with those obtained as solutions of the Linear Programming Model. The details are given below:

Sectors	*Sectoral income for 1974-75 at current prices (Rs. in crores)*	
	Sectoral income expected according to the outlay suggested by the government	*Sectoral income obtained from L.P. Model (implies optimum utilisation of scarce materials)*
Agriculture	1364	1750
Industries	682	610
Power	81	81
Transport and Communication	241	207
Services	1364	1283
Total	3732*	3931*

*This excludes Animal Husbandry, Fishery and Forestry Sectors.

It is seen from the table that if the overall objective is maximising aggregate output within the constraints mentioned above, then output of sectors like Industries, Transport and Services (which includes construction) will be reduced to a greater extent than in the case of sectors like power development and agriculture. In fact, there is greater need for and justification of increased outlay on power development.

Obviously, price rise will affect the various sectors and schemes differently. In general, sectors which use scarce materials, or heavy machinery will feel the impact of price inflation to a much greater extent than industries or sectors whose wage bill constitutes the greater part of their total costs or which have already stocked the scarce materials in anticipation of shortage and higher prices. These details are taken into account in estimating the revised cost of the schemes. Figures showing the original and revised cost of the schemes under the seven sectors are presented in the following table:

Sector	*Original cost 1974-75*	*Revised cost 1974-75*	*Percentage increase in cost*
	(Rupees in lakhs)		
I. Agriculture	1755.25	1939.95	10.6
II. Fisheries	110.55	110.55	—
III. Large Industries	675.00	712.50	5.6
IV. Small Enterprises	192.50	192.50	—
V. Power	4397.60	5628.26	28.0
VI. Transport and Communications	1057.13	1300.53	23.6
VII. Services	3643.36	4065.11	11.6
Total	11831.39	13949.40	17.9

If the resources that can be mobilised will not exceed the originally envisaged amount of Rs.118 crores, then it is necessary to prune down the various schemes so that the outlay on them may be brought down from Rs.139 crores to Rs.118 crores. Considering the solution to the Linear Programming Model and the other criteria mentioned earlier for fixing priorities for the various schemes, it appears to be justifiable to reduce the spendings in the Services sector and Large Industries and to some extent in Transport and Communications. On the other hand, no scaling down is advisable in the case of Fisheries, Power and Small Enterprises and only to a very limited extent in the case of Agriculture. The sectors are listed in the table on p. 48 in the order according to the scope for reduction of outlay. The revised cost of the different sectors is also indicated.

Sectors	*Outlay originally envisaged for 1974-75* (*Rs. in lakhs*) 2	*Revised cost taking into account rise in prices* (*Rs. in lakhs*) 3	*Readjusted cost based on revised priorities* (*Rs. in lakhs*) 4
I. Services	3643.36	4065.11	2987.02
II. Large industries	675.00	712.50	480.50
III. Transport and Communications	1057.13	1300.53	988.99
IV. Agriculture	1755.25	1939.95	1539.29
V. Small Enterprises	192.50	192.50	192.50
VI. Power	4397.60	5628.26	5628.26
VII. Fisheries	110.55	110.55	110.55
Total	11831.39	13949.40	11927.11

A comparison of the figures in Columns 2 and 3 of the table on page 46 will show that optimum utilisation of scarce resources would result in increased output in the Agricultural sector, constant output in the Power sector and reduced output in the other sectors. In other words, scarcity of the basic inputs will affect particularly Industries, Transport and Communications and the Services sectors. And the inference to be drawn from this fact is that reduction of investment outlay in these sectors is justifiable. It also means that other things remaining equal, preference will have to be given to Agriculture and Power development. However, it is important to take into account non-economic factors also, such as administrative feasibility, social needs and policy objectives in making decisions about investment priorities. The solution to the Linear Programming Model should be taken only as a guide in the ordering or ranking of the sectors under the altered circumstances brought on by growing scarcity of some of the basic inputs.

CHAPTER 5

Consistency—Commodity Balance

A plan is said to be feasible if its targets are achievable with the given resources and production structure; it is optimal if there are no alternative ways to raise the value of the targets. It is consistent if the activities of each sector are planned in such a way that no bottlenecks or excesses are likely to arise.

Development results from the productive activity of the different sectors of the economy. Any process of production involves different stages—any one of which depends on the completion of the preceding stage. Furthermore, the output resulting from one productive activity becomes the input of another productive activity. It is therefore clear that the process of production will continue without any hitch only if the different stages of production comprising different productive activities are linked up properly with other activities.

Considering the economy as a whole, a plan for development can be deemed consistent only if it recognises the interdependence of the sectors and provides for the simultaneous development of the sectors in step with one another. Besides, it should ensure that total output or supply plus imports is equal to aggregate demand—the latter being made up of inter-industry demand, consumption demand, government demand and exports. Consistency requires also that there is balanced development among the different regions of a state.

Two methods are employed to ensure consistency in economic planning (1) Material balances or Commodity balances; and (2) Input-Output method.

I. Commodity Balance

A detailed demand supply analysis for purposes of economic planning should cover the three sectors—primary, secondary and tertiary. The analysis has to be based on a scrutiny of all the factors that determine the supply of commodities or services on the one hand, and the demand for these on the other. Thus in respect of the primary sector which includes crop production, animal husbandry, forestry and fisheries, it is necessary to take into account various factors determining demand such as growth of population, age composition and distribution of population between rural and urban areas, trend in per capita income, income elasticity of demand, the pattern of income distribution, etc. So far as supply is concerned, the factors affecting it are changes in the prices of inputs as well as their availability, particularly electricity and fertilisers, rainfall, irrigation facilities, governments' policy measures, etc. A similar analysis is required relating to small and big industries, power development, transport and communications, education, public health and other social services. Besides balance in the supply and demand for goods and services, attention has to be devoted to the achievement of balance in foreign trade and the demand and supply of foreign exchange, balance between savings and investment, between government resources and expenditure and balance between the sectors and regions of an economy. The advantages of such a demand supply analysis in economic planning are summarised by the Perspective Planning Division of the Government of India. "These material balances provide the rationale for fixing output targets of principal commodities in the Plan and give evidence of the balance and consistency of the Plan. The effort required for the preparation of material balances contributes also to the better understanding of the structure of the economy and to the identification and improvement of the data needed for planning. The inter-sectoral relations revealed at this level of disaggregation also help in improving the technological co-efficients used in Input-Output Tables".[1]

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[1] Draft Fourth Plan Material and Financial Balances, 1964-65, 1970-71 and 1975-76. Perspective Planning Division, Planning Commission, Government of India, New Delhi, September 1966, p. 44.

Some basic points to be considered in this connection are indicated below.

Estimating Demand

In general, the method of analysis adopted for estimating demand is first to calculate the present demand for different categories of goods and then to forecast future demand by using the observed elasticity factors in relation to income growth, population growth and other relevant variables.

Expenditure elasticity of demand (η) for commodity '*i*' is derived as follows:

$$\eta i = \frac{C_{1t}}{C_{1o}} \Big/ \frac{X_t}{X_o}$$

Where,

C_{1t} = Per capita consumption expenditure on commodity '*i*' in the year '*t*'.

C_{1o} = Per capita consumption expenditure on commodity '*i*' in the base year.

X_t = Total per capita consumption expenditure in the year '*t*'.

X_o = Total per capita consumption expenditure in the base year.

(*a*) *Demand for agricultural goods*

Agricultural commodities may be grouped into:

(i) Consumption goods—cereals, pulses, vegetables, fruits.
(ii) Industrial raw materials—oil-seeds, sugarcane, cotton.

(i) Some recent estimates have been made by the Food and Agricultural Organisation of the United Nations* about the per capita consumption of food articles, in the various countries of the world including India. According to this study the average per capita consumption of important food items per day in 1960-63 for India was as follows:

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*Agricultural commodities—projections for 1975 and 1985 (Food and Agricultural Organisation of the United Nations, Rome, 1967, Vol. II, p. 102).

Cereals	382 gm
Pulses	69 gm
Roots and tubers	29 gm
Vegetables	8 gm
Fruits	48 gm
Sugar	54 gm
Oil and ghee	54 gm

In calculating the future per capita demand, the income elasticity of demand for food items is taken into account.

Generally, for making demand projections in India, the double-log demand model which implies a constant elasticity throughout the projection period is used. But in actual fact, particularly in a growing economy, the form of the demand function is likely to change. Thus for those commodities in which the initial consumption levels are rather low, but the prospective demand for which (the consumption) might be expected to remain far below the saturation level, the double-log function may be used. On the other hand, in cases in which the elasticity co-efficient declines in proportion to the increase in per capita income, the log inverse function may be appropriate.*

After fixing the per capita demand in the base year (Y_0), the demand in the future can be estimated by applying the value of the elasticity factor. In this manner the per capita demand for the food items is estimated for the future years on the basis of the projected income for these years. The figures obtained in this manner represent per capita consumption per day in grams. By multiplying this figure by 365 and the anticipated population of the respective years the aggregate consumption demand in real terms is calculated. Since prices are assumed to be constant, the relevant money values can be estimated by using the prices of these items in the base year.

(ii) As regards industrial raw materials (which are the products of the agricultural sector, since they are used as intermediary products, their demand may be arrived at by the application of end use analysis. First, the major consuming sectors and their sub-sectors are to be identified. Second, determination of input norms in the past on the basis of observed data and allowing for variations in the future due to technological changes may be noted. Third, calculation is to be made of the quantity required of these industrial materials with reference to the targets of production of the using sector. Four, demand on account of addition to stocks and other uses is to be estimated.

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*Report of the National Commission on Agriculture, 1976 Part III—Demand and Supply, Government of India, Ministry of Agriculture and Irrigation, New Delhi, 1976, p. 30.

The important industrial raw materials for which demand estimates have to be made are oil-seeds, sugarcane and raw cotton. In the case of these commodities the forecasting of demand is done on the basis of income elasticity of demand for the final product, i.e., oil, sugar and cotton clothing. When this is known, the demand for the raw materials is computed by applying suitable conversion factors indicating the number of units of the raw materials required to produce one unit of the final commodity.

(*b*) *Demand for manufactured consumption goods*

The per capita demand for manufactured consumption goods is calculated from family consumer expenditure data furnished by the National Sample Survey. It should, however, be remembered that National Sample Survey estimates of consumer expenditure are under estimates to the extent of about 10 per cent. Hence suitable allowance is to be made in determining average per capita demand for manufactured consumption goods in the base year. But while the average per capita expenditure can be estimated in this manner there is difficulty in allocating these among the different commodities. One way out of this difficulty is to classify the consumption goods into primary goods, goods manufactured in the large-scale manufacturing sector and those produced in the small-scale manufacturing sector. The proportion spent on each of the consumption goods is thus distributed among the three classes mentioned. From this data it is possible to find out the distribution of consumption expenditure among the three broad categories. This is illustrated below:

Distribution of consumption expenditure among different items

Commodities	*Per capita expenditure expressed as percentage*	*Percentage distribution of expenditure among*		
		Primary goods	*Large-scale manufacture*	*Small-scale manufacture*
1. Cereals	37.0	35.0	—	2.0
2. Pulses	4.1	4.1	—	—
3. Milk and its products	4.1	4.1	—	—
4. Edible oil	3.2	—	2.7	0.5
5. Meat, eggs and fish	3.7	3.7	—	—
6. Vegetables, fruits, etc.	4.6	4.6	—	—
7. Sugar, salt and spices	5.8	—	4.0	1.8
8. Beverages	6.5	—	4.0	2.5
9. Pan, Tobacco and intoxicants	2.7	—	2.0	0.7
10. Clothing	5.7	—	3.8	1.9
11. Fuel and light	6.9	0.6	4.0	2.3
12. Miscellaneous goods and services	13.8	—	9.2	4.6
13. Durable goods	1.9	—	1.9	—
Total	100.0	52.1	31.6	16.3

From the above table it is seen that food articles and fuel and light (considered as basic consumption items) take up 52.1 per cent of the total while large-scale manufactured goods account for 31.6 per cent and small-scale manufactured goods 16.3 per cent. The per capita consumption expenditure of the base year may be divided in this proportion among the three categories of goods.

From the base year data the future per capita demand for manufactured consumption goods is calculated on the basis of an income elasticity of demand (η) of 1.75.* The equation used for making this projection is

$$D_t = D_o (1 + g) \eta^t$$

Where

D_t is per capita demand in the specified year
D_o is per capita demand in the base year
η is co-efficient of income elasticity of demand
t is time interval
g is rate of growth of per capita income.

(*c*) *Demand for capital goods*

Demand for capital goods is estimated with reference to the total investment outlays projected for the plan period. It may be assumed that on the average 75 per cent of any investment outlay represents the cost of capital goods and 25 per cent represents labour costs. Of the capital goods which are required for investment, 70 per cent may be assumed to be the products of the large-scale sector and 30 per cent that of the small-scale sector.

(*d*) *Demand for electricity*

The demand for electrical energy comes from different sectors—the household, agriculture, industry and transport and miscellaneous. As regards the first three sources of demand, certain independent variables relevant to each sector and which have a bearing on the growth of consumption of energy may be considered and regression lines fitted with time series data for, say ten years preceding the base year.

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*The income elasticity of demand for manufactured goods is higher than for foodstuffs. In Brazil for 1937-49 income elasticity of demand for food, textiles, clothing, footwear and cigarettes was 1.2 or less; furniture, motor cars and electrical fittings 2.0 to 2.5; in Columbia (1925-53) it was 1.10 for non-durable goods and 1.50 for durable commodities; for paper 2 to 2.5.

Analyses and Projections of Economic Development (United Nations, 1955), p. 32.

D_e or demand for electrical energy is treated as the dependent variable. Domestic or household consumption is considered to be affected by the size of urban population and net domestic product at constant prices. The regression line for this relationship is

$$D_{e1} = a + bN + cY$$

Where N and Y represent the independent variables—urban population and net domestic product respectively.

In the agricultural sector, consumption of electrical energy depends on the number of pumpsets energised. If D_{e2} represents the dependent variable, the equation is

$D_{e2} = a + bP$ (P is number of pumpsets)

Consumption of electrical energy in the industrial sector is determined by the level of industrial production (X) and net domestic product at constant prices, i.e.,

$D_{e3} = a + bX + cY$ (X is industrial production)

Using these regression lines and the estimated values of independent variables, the demand for electrical energy in each of the sectors in million units may be worked out. The value in money terms is found by multiplying demand in real terms by the average cost per million units.

As regards demand for electrical energy in the transport sector and other miscellaneous demand, official estimates which are reported periodically, may be used. In order to provide for peak demand a suitable extra amount say 20 per cent has to be allowed for in the estimate worked out in the aforesaid manner.

(e) *Demand for the services of the tertiary sector*

The output of the tertiary sector is in the form of services—transport, banking, education, public health, etc. It is possible to make only a rough estimate of the demand for these services by assuming that the value of the service represents the demand for it. The value of the service is actually the income generated in the sector. In the case of a service sector like transport and communications a projection of future demand can be made on the hypothesis that both the growth of a country's income and its population would affect demand for transport service. This may be expressed as

$$T_d = a + bY + M$$

Where T_d is demand for transport, Y is national income, and M, population. Using the estimated population size in the plan period and the targeted income growth it would be possible to make a rough estimate of the demand for the service. It is needless to add that if the forecast is to be more realistic, other variables will also have to be considered and incorporated in the model.

Estimating supply of output

In order to find out whether increase in demand consequent on the growth of the economy and the rise in the level of incomes would be matched by increase in the output of the different sectors of the economy, it is necessary to forecast the trends on the supply side also. This involves two stages: First, the supply position in respect of the important sectors of the economy in the base year is to be determined; next, a projection is to be made of the growth of output in the plan period. This increase in output, of course, depends on the performance of each sector in response to the increased investment and structural and organisational changes envisaged in the plan. This would mean that for purposes of estimating supply of output for the different sectors, reliance will have to be placed on past performance and achievements as well as on the proposals for future development. The proposals incorporated in the final plan may be tentatively accepted as indicative of the potential supply. This is necessary because in the case of some of the sectors, particularly agricultural production, supply depends on various factors such as area under cultivation, extent of irrigation, use of fertilisers, adoption of improved production methods, land and water management, intensity of cropping, change in cropping patterns and perhaps most important of all, seasonal conditions. It is not possible to take into account all these variables in making any projection of supply. Some of these factors are influenced by government's attitude and policy. Seasonal factors are not predictable.

One feasible method is to make a projection based on time trend. Here the assumption is that the trend in the production of certain commodities observed in the past will on the whole hold good for the next few years also. To the extent the past trend has been influenced by the several variables mentioned above, it is plausible to assume that a projection based on time trend would automatically take into account the effect of these determinants. In other words, all these factors are subsumed in the time trend.

Proceeding on this basis, estimates of production of selected agricultural and allied commodities may be computed* by fitting an equation of the following form to the time series:

$$Y = ab^t$$

Where Y stands for production; t is time measured in years; 'a' and 'b' are constants.

The net available supply for consumption is arrived at by deducting a few items of use from total output. These are: (i) Demand for seed; generally, the requirements for seed are put at 5 per cent of gross production. It is likely that with the introduction of new varieties and new technology this proportion may decline slightly in future. (ii) A proportion of 5 per cent of the gross production of foodgrains is currently being used for livestock feed purposes. But since demand for milk and other animal products would go up with increase in income and rise in the standards of living, it is possible that the allowance of 5 per cent of gross production for feed requirements may be insufficient. Finally, another small fraction of total production is written off, on account of post harvest losses arising in the process of threshing, transport and storage. Usually 2.5 per cent of gross production has to be allowed for on this account but the current view of experts is that this proportion must be appreciably larger; it may be even 6 to 8 per cent. The National Commission on Agriculture, however, feels

*Draft Fourth Plan: Material and Financial Balances, Government of of India, Planning Commission, New Delhi, September 1966, p. 33.

that it would be realistic to fix it at 4 per cent. Thus in all, for seed, and feed purposes and post harvest losses a deduction of 15 per cent is to be made from gross production for the plan period. Making allowance for these items the net availability to meet the expected demand has to be arrived at. In respect of the other sectors an analysis on the above lines with suitable modifications may be made. However, it is important to remember that the targets set in the plan and the pattern of sectoral growth which it envisages should be considered as only a framework from the point of view of the study of material balances. The preparation of the balances data actually forms part of the exercise of planning. The plan at the different stages of formulation will have to be compared with the material balances data and both will have to be modified and improved upon on the basis of such comparison. Viewed in this manner, the plan targets of output and the estimates of demand will be influenced by the forecast figures in the material balances. On the other hand, given the plan figures regarding supply and demand, the material balances data will have to be revised. In the final analysis, such revisions and modifications will result in the plan being drawn up in such manner that discrepancies between the two sides, i.e., demand and supply will be reduced to the minimum.

CHAPTER 6

Consistency—Input-Output Analysis

Commodity or material balances data provide a means by which the emergence of any excess of demand over supply or any shortfall in supply compared with demand can be identified. This enables timely measures being taken to close the gap between the two sides or keep the gap within limits. It should, however, be noted that an elaborate statement showing the expected demand and supply position of the various sectors of the economy does not bring out the inter-dependence of the sectors. But an analysis of this inter-dependence is necessary because the expansion of any one sector consequent on the increased demand for its product would necessitate expansion of the other sectors which supply the inputs of the first. This effect will be both direct and indirect. The more advanced the economy and the larger the number of distinct sectors and the greater their inter-dependence, the greater will be the inter-sectoral effects of what happens to any one of the segments.

The technique which is commonly used for studying inter-industry relationship is the input-output method which has become a powerful tool in theoretical analysis as well as for purposes of practical planning. The economy is divided into several sectors or units which are listed along a row and a column. The row figures indicate the amounts supplied by one industry to other industries and used by the latter in their production processes. The column figures denote what is taken in by a particular industry from other industries as its inputs. These figures relate only to supply and demand within the industries in their productive activity. But demand and supply within the industries form only part of what is produced by each industry. The remaining part meets other needs and is accounted for by "final demand" which is the sum of consumption, investment and exports minus imports. Sectoral demand plus final demand is "total demand". Down the columns, the inputs of each sector (i.e., outputs of other industries received as inputs) are marked. Total inputs plus value added give total income or supply of each sector. A simple arithmetical illustration is given below:

Sales/Purchase					*Sectoral demand*	*Final demand*	*Total demand*
	X_1	X_2	X_3	X_4			
X_1	20	15	10	12	57	43	100
X_2	8	30	25	18	81	65	146
X_3	13	17	22	8	60	52	112
X_4	7	20	23	25	75	47	122
	48	82	80	63			480
Value added	25	64	73	45			
Total Income supply	73	146	153	108			480

The model assumes homogenous production function, a linear relationship between factors and output, constant returns to scale, no joint production and no external economies. The product of industry X_1 used in another industry, say, industry X_3, forms a certain proportion of the value of output of X_3. The ratio of the amount of the product of X_1 used for producing one unit of the output of X_3 is the technical co-efficient in respect of that industry. Thus, in the illustration above, total output of $X_3 = 112$; the amount of X_1's product used by X_3 is 10; hence the technical co-efficient is $10 \div 112$ or 0.09. If there is any increase in the total demand for the product of X_3, then not only will more inputs from other sectors be required by

X_3 but the capital capacity of X_3 should also increase, i.e., there should be additional investment in X_3. This requires more investment goods, materials for which would have to be supplied by other industries. Hence capital co-efficients have also to be calculated. Thus there can be a separate technical co-efficient matrix and another capital co-efficient matrix or there can be a double cell matrix, one cell containing the technical co-efficient and the other the capital co-efficient. An input-output table will be typically of the form:

$$\begin{aligned}
X_1 &= a_{11}X_1 + a_{12}X_2 + \ldots + a_{1n}X_n + d_1 \\
X_2 &= a_{21}X_1 + a_{22}X_2 + \ldots + a_{2n}X_n + d_2 \\
&\ldots \quad \ldots \qquad \ldots \quad \ldots \\
X_n &= a_{n1}X_1 + a_{n2}X_2 + \ldots + a_{nn}X_n + d_n
\end{aligned}$$

The terms denote technical co-efficients, i.e., the quantity of the i^{th} output required to produce one unit of the j^{th} commodity; the last term '*d*' denotes final demand made up of consumption plus investment plus exports minus imports. Thus we find in any one row the total output of any one industry say, X_2 and how this total output is distributed partly among the different industries and partly as final demand. Since the technical co-efficients are given and the value of '*d*' is known, the required output, X can be found for any variation in '*d*' by solving for X.

For solving the simultaneous equations, the technical co-efficients are presented in a matrix and the industries $X_1 \ldots X_n$ and final demand figures are arranged in column vectors. Total demand minus final demand is the sum of the demand by different sectors. The technical co-efficients are expressed as fractions of one. Hence, when out of 1, the sectoral requirements are deducted, the balance will be equal to the fraction of the final demand: that is, sectoral demands + final demands = 1.

$$\begin{pmatrix} (1-a_{11}) & -a_{12} & \dots & -a_{1n} \\ -a_{21} & (1-a_{22}) & \dots & -a_{2n} \\ \cdot & & & \\ \cdot & & & \\ \cdot & & & \\ -a_{n1} & -a_{n2} & \dots & (1-a_{nn}) \end{pmatrix} \begin{pmatrix} X_1 \\ X_2 \\ \cdot \\ \cdot \\ \cdot \\ X_n \end{pmatrix} = \begin{pmatrix} d_1 \\ d_2 \\ \cdot \\ \cdot \\ \cdot \\ d_n \end{pmatrix}$$

The **matrix** equation is $\mathbf{(I-A)\ X = d}$; A is the coefficient matrix. $X_1, X_2 \dots X_n$ represent total demand and $d_1, d_2 \dots d_n$ the final demand. If the inverse of $(I-A)$ exists that is, if there is $(I-A)^{-1}$, then $(I-A)^{-1}(I-A)X = (I-A)^{-1}d$

i.e., $IX = (I-A)^{-1} \cdot d$

i.e., $X = (I-A)^{-1} \cdot d$

(For the method of finding the inverse of matrix, see Appendix).

The inverted co-efficient matrix multiplied by the d column vector gives the solution for required values of X or total output. By giving different values for d, we can calculate the required values of X, i.e., output of $X_1 \dots X_n$ needed. Suppose we have the inverted co-efficient matrix, then

$$\begin{pmatrix} X_1 \\ X_2 \\ X_3 \end{pmatrix} = \frac{1}{0.384} \begin{pmatrix} 0.66 & 0.30 & 0.24 \\ 0.34 & 0.62 & 0.24 \\ 0.21 & 0.27 & 0.60 \end{pmatrix} \begin{pmatrix} d_1 \\ d_2 \\ d_3 \end{pmatrix}$$

0.384 is the value of the determinant of the matrix. d is the final output target in which $d_1=10$, $d_2=5$, $d_3=6$ in crores of rupees. Then

$$X_1 = \frac{1}{0.384}\,[0.66(10)+0.30(5)+0.24(6)] = \frac{9.54}{0.384}$$

$= 24.84$ crores.

Similarly, $X_2 = 20.68$ crores and $X_3 = 18.36$ crores. It means that, when the output of X_1 is fixed at 24.84 crores, the output of X_2 and X_3 should be 20.68 crores and 18.36 crores, if there is to be consistency in the whole production programme.

Introducing a Dynamic Element

A development programme lasts over a few years and the planner has to envisage dynamic changes in the economy involving technological changes which imply changes in both technical and capital co-efficients. The illustration of the input-output model given above is a static one in which we assume constancy in the technical co-efficients. By anticipating technological changes and estimating the possible variations in the combination of inputs, it would be possible to apply revised ratios at desired intervals of time (say, 3 years each) and modify the calculations accordingly. Furthermore, allowanace will have to be made for changes in capital co-efficients as well. The available investment for a sector is total output of that sector minus its total supplies to the other sectors and for final consumption demand. This residual amount multiplied by the sector's capital co-efficient will give the output of capital capacity for the next year. With that as the basis for the next year, the capacity level of production for the third year can be calculated. This is how the dynamic input-output model can be used to build up a long-term economic projection. Values of the co-efficients will have to be adjusted after each calculation in the light of experience. In this way a more consistent and satisfactory economic plan can be formulated.

The brief account of linear programmig given in Chapter 4 and the input-output method outlined in the present one bring out clearly their complementary nature. While linear programming helps in formulating a streamlined model for a particular sector or for the economy, the input-output method facilitates checking up the mutual consistency of the sectoral programmes. Further, the data collected for a fairly detailed input-output table will be of great use in identifying the inter-relationship between basic economic variables which in turn would help in refining the sectoral models. For this reason, it would be ideal to start any serious exercise at comprehensive planning for an economy with a detailed study of the inter-industry relationships.

Data needed for an Input-output Model

The reliability of an input-output model depends greatly on the number of sectors which it incorporates and the accuracy of the data used for calculating the co-efficients. First, total production figures are to be obtained and the production of each sector is to be estimated. Value of output of each sector can be found by multiplying the physical quantities of each commodity produced during the year by its price and then adding up. The second step is to compute the final demand. Foreign trade statistics give figures showing aggregate exports and imports commodity-wise, which can be apportioned among the different sectors. Similarly, making use of statistics relating to consumption patterns of different income groups, the aggregate demand for final consumption goods can be estimated. The third step is to calculate inter-sectoral flows. This can be done by either tracing the sales of each sector's output to their final destination or by estimating the value of inputs of each sector directly. If both the methods are used, one can be checked with the other and a more reliable set of final figures can be arrived at. Lastly, as for capital transactions, which are the most difficult to estimate, reliance has to be placed on existing statistics. And if they are inadequate, the only alternative is to be satisfied with the data for the total amount of each sector's output allocated for the purpose of investment.

It is necessary to add that, in order to get fairly reliable data, we have to collect figures for a few consecutive years and then calculate the co-efficients.

The input-output method has been tried in some of the under-developed countries, but its reliability is questioned and while much time and talents are devoted to it as a theoretical exercise, there is a great deal of hesitation in taking it seriously as a basis for practical planning. One severe limitation in under-developed countries is the fact that the interflow of inputs and outputs as between sectors is very much limited compared with developed countries. The number of major sectors is small and most of their output is consumed by themselves; the flow to the other sectors is negligible so that if a detailed input-output table is prepared, the technical co-efficients get concentrated in the diagonal cells, and in the others, the values of the co-efficients tend to be far too small to have any statistical significance. Clearly, any forecasting made on the basis of such a model will be highly misleading.

Nevertheless, even an elementary input-output framework can be of some help in making forecasts of certain fundamental variables. It can be easily shown that simple calculations with the help of such a model would contribute greatly to consistency in a development plan. Consider a model with only two industries whose total outputs are 300 and 200 each and the distribution of their respective outputs is as shown below:

	Industry I	*Industry II*	*Investment*		*Consumption*	*Exports*	*Imports*	*Total*
	(X_1)	(X_2)	I_1	I_2	C	E	M	
Industry I (X_1)	60 (0.2)	40 (0.2)	7	6	167	30	—10	300
Industry II (X_2)	30 (0.1)	80 (0.4)	28	18	74	20	−50	200
Income Payments (value added)	210	80						290
Total	300	200	35	24	241	50	—60	

Capital co-efficients are more difficult to compute than technical co-efficients. But even without capital co-efficients, an input-output table can be of use in determining the level of production in each sector to meet the demand for "the final bill of goods". In the above example, the final demand for the output of industry I (X_1) is 200 and that of industry II (X_2) is 90 $(I+C+E-M)$. From this it is possible to compute the total output of X_1 and X_2 which is consistent with final demand. The ratio of output of X_1 used in X_1 itself to the total output of X_1 is 0.2 (60/300) and the ratio of the output of

X_1 used as input in X_2 to the total output of X_2 is also 0.2 (40/200). The other two corresponding co-efficients are 0.1 (30/300) and 0.4 (80/200) and are shown within parentheses in the table.

Let us assume that we are given only the value of technical co-efficients and the final demand figures and that total output figures (in the last column) are not known. The data available can be expressed in two equations with two unknowns (X_1 and X_2) and by solving, the values of X_1 and X_2 can be found.

$$\begin{aligned} X_1 &= \cdot 2X_1 + \cdot 2X_2 + 200 \\ X_2 &= \cdot 1X_1 + \cdot 4X_2 + \ 90 \\ \text{i.e., } X_1 &= 300;\ X_2 = \ 200 \end{aligned}$$

The values of X_1 and X_2, 300 and 200, are important in that they are the only figures (given the technical co-efficients) that would balance inter-sectoral demand and final demand.

The value of the above mentioned techniques for planning purposes depends very much on the availability of accurate data and competent experts to handle them. A mathematical model can be useful as a forecasting tool only if the parameters incorporated in it represent correctly the functional relationships in the real world. Apart from this, even in advanced countries, the practical value of these techniques has come in for serious criticism. The fundamental objection is that both linear programming and input-output analysis are based on highly arbitrary assumptions such as the linearity of production functions and constant returns to scale. In reality, the techniques of production and the proportion in which the factors are combined change so frequently that any calculation based on static assumptions loses all its practical significance. An improvement in the organisation of a business or the streamlining of its administrative set up would have a noticeable effect on its returns and profits, but the factors responsible for this improvement cannot find a place in any mathematical model. It is true that the techniques are being continuously refined and methods are evolved for tackling the problem of change and for optimisation in a dynamic setting. Yet, the difficulties and problems remain, reducing the chances of accurate forecasting.

Despite their limitations, modern statistical and mathematical devices such as sectoral and aggregate econometric models, input-output technique and linear programming have certain decided advantages which need to be brought out. Undoubtedly, these techniques are an aid to systematic thinking on fundamental issues involved in planning for development. The inter-related variables in a modern economy, even when it is an under-developed one, are so numerous that their relative significance and the effects of their interaction can be understood only within the framework of a comprehensive model. Further, the very difficulties that arise when an attempt is made to formulate a model and to apply it are a source of some benefit insofar as they necessitate the collection of more detailed and more accurate statistical information which in turn facilitates further refinement and improvement of the models, and the discovery of new inter-relationships between economic variables.

One important point in favour of a mathematical model particularly the input-output model, is that it helps in evaluating the possible effects of implementing different policy proposals or in suggesting alternative strategies for achieving the same objective. Assuming that the government's policy is to increase investment or raise the levels of export or consumption, the question arises as to what extent sectoral of allocations are to be revised and modified. Given a set of values parameters and exogenous variables, the model generates a unique solution. A change in these brings about a change in the results. For example, a programme of rapid industrialisation has important effects on exports and imports, on the agricultural sector, on the demand for consumption goods and investment goods, on the employment level, etc. Unless these changes are estimated and provision made for meeting the demands arising out of these changes, a development plan cannot serve its purpose.

This underlines the need for avoiding any sweeping denunciation of quantitative analysis or theoretical models on the ground that they are abstract or unrealistic. A theoretical model is nothing more nor less than an aid to focus attention on the basic inter-relationships governing the behaviour of economic variables. It is a safeguard against loose thinking on the part of the planner whose mind is otherwise likely to get bogged down in unnecessary details. The plan that would be drawn up only on the basis of a mass of factual data and on intuition and subjective opinion would be little better than an incoherent assemblage of tiresome details and hollow platitudes and would be definitely less practicable than one based on an internally consistent theoretical framework. Unfortunately, quite often this prejudice arises out of the lack of a dialogue between the so-called model builders and those engaged in planning and policy-making. A little effort on the part of the latter to understand the language of the former would enable them to examine the merits of the case with an open mind. Today it is possible to plan not only economic development projects but social and welfare projects as well, the determinants of which cannot easily be quantified. Furthermore, techniques have now been evolved which have widened the plan horizon over time also, enabling the planner to conceive of methods of ensuring stability in economic progress for many decades ahead. But the development of powerful tools of analysis and techniques should not blind us to the fact that the concern for man and his destiny should be the chief interest of all technical effort. It is important to make sure that the planner does not forget this among his diagrams and equations.

APPENDIX

The Inverse of a Matrix

The inverse of **Matrix A** is expressed as $\mathbf{A}^{-1}$

$$\mathbf{A}^{-1} = \frac{\text{adj}\mathbf{A}}{|\mathbf{A}|}$$

i.e., inverse of **Matrix A** is the adjoint of A divided by the determinant of A.

The adjoint of A is the transpose of the co-factor **matrix** of A. Co-factor **matrix** of A is calculated by replacing each element of A by its co-factor. Consider a **matrix** of order 3 (i.e. having 3 rows and 3 columns) such as

$$\mathbf{A}=\begin{pmatrix} 1 & 2 & 3 \\ 2 & 3 & 2 \\ 3 & 3 & 4 \end{pmatrix}$$

The element in the first row, first column is 1. Its co-factor is calculated by deleting the row and column in which it occurs and multiplying the first diagonals of the remaining four figures and subtracting from their product, the product of the second diagonals. First, keep out the first row and first column. Then $(3 \times 4)-(2 \times 3) = 6$; 6 should take the place of 1. And the sign to be assigned to the number is determined by multiplying it by $(-1)^{i+j}$ where i is the row number and j is the column number. Since the place of the element 1 is first row and first column $i + j = 1 + 1 = 2$; hence $(-1)^2 = 1$; i.e., 6 which now takes the place of 1 should be given a positive sign. The co-factor of the element in the first row second column namely 2 is $(2\times 4)-(2\times 3) = 2$. This number, i.e., 2, now takes the place of the original 2 in the **matrix**. The number of the row is 1 and the number of the column is 2 and $i + j = 1 + 2 = 3$ an odd number. Hence 2 now has to be given a negative sign because $2(-1)^3 = -2$. Working in this manner, the new element in the **matrix** will be

$$\begin{pmatrix} 6 & -2 & -3 \\ 1 & -5 & 3 \\ -5 & 4 & -1 \end{pmatrix}$$

This is the co-factor **matrix** and is expressed as $\mathbf{A}^c$. The co-factor **matrix** is transposed by changing the elements of rows to elements of columns. Thus we have

$$\begin{pmatrix} 6 & 1 & -5 \\ -2 & -5 & 4 \\ -3 & 3 & -1 \end{pmatrix}$$

This is transpose of the Co-factor **matrix** and is expressed as $A^{c'}$.

The determinant of **Matrix** A is calculated in the following way: Select any row or column, multiply each element by its co-factor and add up the products. Thus elements in the first row of **Matrix** A are 1 2 3. Their co-factors are 6, −2, −3. Hence determinant of the **matrix** is $1\,(6) + 2\,(-2) + 3\,(-3) = -7$.

Adj of **matrix** A divided by det A is the inverse of A $A^{-1} = \frac{\text{Adj } A,}{|\ A\ |}$ i.e.,

$$-1/7 \begin{pmatrix} 6 & 1 & -5 \\ -2 & -5 & 4 \\ -3 & 3 & -1 \end{pmatrix}$$

$$\text{i.e.,} \begin{pmatrix} -6/7 & -1/7 & 5/7 \\ 2/7 & 5/7 & -4/7 \\ 3/7 & -3/7 & 1/7 \end{pmatrix}$$

$A^{-1}\ A = I$, I being the identity **matrix** and

$$\begin{pmatrix} -6/7 & -1/7 & 5/7 \\ 2/7 & 5/7 & -4/7 \\ 3/7 & -3/7 & 1/7 \end{pmatrix} \times \begin{pmatrix} 1 & 2 & 3 \\ 2 & 3 & 2 \\ 3 & 3 & 4 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

Thus the principle in solving a system of linear equations is: first isolate the co-efficients which are constants and arrange them in **matrix** form, **Matrix A**. Arrange the unknown variables on the left-hand side of the equation in a column vector, x. Arrange the known variables on the right-hand side of the equation in another column vector d. Then the equation is $\mathbf{Ax}=d$. Invert **matrix A** and multiply the inverted **matrix** by d. We then get the value of X.

$\mathbf{Ax}=\mathbf{d}$
$\mathbf{A}^{-1}\,\mathbf{Ax}=\mathbf{A}^{-1}\mathbf{d}$
$\mathbf{A}^{-1}\,\mathbf{A} \;=1$
hence $\mathbf{Ix}=\mathbf{A}^{-1}\mathbf{d}$
but $\mathbf{Ix}$ is $\mathbf{X}$
hence $\mathbf{x}=\mathbf{A}^{-1}\mathbf{d}$

CHAPTER 7

The Tools of Economic Planning—
I. The Capital Output Ratio

Apart from the techniques of planning outlined in the preceding chapters, there are certain other tools which are found useful for drawing up sectoral development programmes for making financial allocation among the various sectors of an economy as well as for project formulation and for evaluating the worthwhileness of a project. These are: (1) the capital output ratio, and (2) the cost-benefit analysis. These two concepts will be examined in some detail in the present and in the next chapter.

Capital, working along with the other factors of production contributes to growth. In fact, the proportion of income saved and invested each year broadly determines the rate of income growth. It is this quantitative relationship between capital formation and income growth that is brought out in the concept of capital output ratio. This ratio has assumed much prominence in discussions of the possibilities of income increase resulting from investment, and has been made use of increasingly in theoretical analysis as well as in planning for development.

Meaning of the Term

In simple terms, "the capital output ratio may be defined as the relationship of investment in a given economy or industry for a given time period to the output of that economy or industry for a similar time period"[1]. At the outset, this concept has to be distinguished from the concept of marginal productivity of capital. The latter indicates the contribution of capital alone—(other factors are assumed to be constant)—to total output while the former assumes increase in the other inputs as well. Thus while marginal productivity of capital ranges from about 5 to 10 per cent the contribution of capital in combination with other factors which also vary, is bound to be much higher—25 to 40 per cent—normally. In other words, capital output ratio can be the same as the marginal product of capital only if the contribution of the other factors, land and labour is zero.

The difference between the average and incremental or marginal capital output ratio is also to be noted. The first is the quantitative relationship between the stock of capital available in a period of time and the output of that time period. On the other hand, the more widely used concept of incremental capital output ratio (ICOR) is the relationship between the net capital formation of a certain time period and the additional net output that results in the first subsequent time period in which the effects of that capital formation can be fully felt[2]. This of course is based on the logical assumption that capital formation causes an increase in output, i.e., capital formation has to precede the increment in output that results from it. What period of time should elapse before the effect of investment is felt depends obviously on the nature of the investment. Some writers recommend allowing a period of 2 or 3 years for the evaluation of the direct and indirect results of the investments[3]. However, because of the practical difficulties in a calculation of this sort, the incremental capital output ratio is usually interpreted as the relationship between the increment of capital and increment of output with a one-year lag.

Another distinction is between gross capital co-efficients and net capital co-efficients. The former refers to the relationship between fixed capital in the economy and the gross value of output, while the latter relates to the fixed capital and net output, i.e., after deductions are made for the value of goods, raw materials, fuel, light, power, etc., used in the process of production and depreciation charges. Also since the investment and output in the economy cover investments and outputs in different sectors of industries, it is possible to make use of capital co-efficients of particular sectors of industries in investment decisions pertaining to individual industries. The capital output ratio for the economy as a whole is the average of the sectoral ones weighted by the output increase in the different sectors. Obviously, the overall ratio depends on the weights given to the separate units and the relative degree of capital intensity in the different sectors.

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[1] Rosen, George, *Industrial Change in India*, Asia Publishing House, Bombay, 1959, p. 37.

[2] Economic Bulletin for Asia and Far East. U.N., New York, November, 1955, p. 26, f.n.

[3] Analysis and projections of economic development, U.N. Geneva, 1955, p. 21.

Use of the Concept

The practical value of the concept of capital output ratio for planning purposes consists in the fact that it helps to make a quantitative assessment of the capital requirements of any development programme. The policy objective may be to develop the agricultural or small industries sector at a faster rate than the other sectors. Suppose the objective is to increase the output of the small industries sector by, say 10 per cent. Assuming constant prices, the extent to which the value of output of this sector is to go up at the end of the plan period can be easily calculated. This increase has to be contributed by the various units coming under the category of small industries. The capital output ratio pertaining to the small industry sector indicates the increase in investment necessary to bring about a certain increase in income. Similarly if individual ratios can be worked out for the different units constituting the small industry sector, it would be possible to allocate optimally the investible resources among these various groups.

So far as overall investment in the economy is concerned, the aggregate ratio for the economy as a whole indicates broadly the magnitude of investment necessary for ensuring a certain rate of growth of income. Similarly, given the rate of growth of population, if the objective is to raise per capita income by a certain margin, the investment required can be calculated. Thus if the capital output ratio is 3 : 1 and 9 per cent of the country's income is invested, then income grows at the rate of 3 per cent per year. If the desired rate of growth is 4 per cent then correspondingly, 12 per cent of the income is to be saved and invested. Or in the alternative, steps should be taken to lower the capital output ratio to 2.25 : 1 by intensive use of existing capital and labour and by adopting capital saving technology. Proceeding in this line, if population increases at the rate of 3 per cent per year, a 3 per cent increase in income will keep per capita income constant. But if the latter is to increase by, say 1.0 per cent (i.e., to 4 per cent) and if population growth and capital output ratios are constant, then investment should be 12 per cent of income. Obviously, it also means that the same end can be achieved by reducing the rate of growth of population and by lowering the capital output ratio.

Further, the quantitative relationship established between capital and output (C.O. ratio) and between capital and labour (C.L. ratio)[1] helps to examine the scope for factor substitution in a planned economy. Most of the under-developed countries are faced with the problem of abundance of labour and scarcity of capital. In general, it is assumed that in such countries the right technique of production or the proper investment pattern should be one which conforms to their factor supply situation; and this means that they should go in for labour intensive and capital light schemes. This however, turns out sometimes to be a misleading assumption. As would be shown presently, in determining the optimum combination of labour and capital in any productive enterprise, we have to take into account not only the supply of these factors but also the wage rate, the interest rate and the scale of operations. It has been pointed out that the lowest capital intensive technique applied to the smallest lot size and the highest mechanised technique with the largest lot size are equal.[1] Nevertheless, given the scale of operations which is feasible, if the planner is to give any guidance in the matter of choice of techniques he should have reliable information regarding capital output ratio as well as capital labour ratio and labour output ratio.

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[1] If C.O. ratio is expressed as C/O and output per unit of labour is O/L then capital labour ratio is $\frac{C}{O} \times \frac{O}{L} = \frac{C}{L}$.

Limitations of the Concept

The quantitative relationship between investment and output which the capital-output ratio suggests is, however, deceptive. In fact, no precise calculation of the ratio for an economy or even for an industry is possible, and as such, no exact estimate can be made of the capital requirements in an economy on the basis of an assumed capital co-efficient in order to bring about a certain rate of growth of income. The limitations of the concept partly spring from the fact that it is not possible to measure the two sides of the ratio with any degree of exactness. On the one hand, the concept of capital is nebulous and any attempt to make a quantitative assessment of it is beset with formidable difficulties. Apart from the index number problem, no clear demarcation between capital goods and non-capital goods is possible. A substantial part of the savings gets invested in land and labour which adds to the productive efficiency of these agents, but the magnitude of capital formation that takes place in this manner is not known. Besides, some durable consumption goods are productively employed but they do not enter into any computation of the capital stock of society. On the other hand, the calculation of output is also not based on any clear cut definition and is subject to a considerable margin of error. Given the capital cost, the choice of gross output instead of net output, to calculate the ratio, results in substantial divergency between the two. As between two industries in which the same investment is made but the durability of capital in the two varies, the capital-output ratio calculated on a net out-put basis will be the same for both but if the calculation is on the basis of gross output the ratio will be higher for the investment which has a longer life. This is so because depreciation charges which are included in gross output will be greater for the short lived equipment.* Again in the case of investment in social overheads which account for a good part of capital formation in growing economies, there is no possibility of estimating the returns in so far as they spread over a long period of time and confer both direct and indirect benefits on the various enterprises in the economy. The time pattern of investments or the lag between investment and yield presents another problem in measurement. Investment in retail trade for example has a quick turnover and the relationship between capital invested and returns is easily known, but in the case of other investments in which the gestation period is long and the yield spreads over a long period of time, as in rubber plantation, it is impossible to estimate the annual returns on the investment.

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[1] Boon, Gerard Karel, "Economic choice of human and physical factors in production", North Holland Publishing Company, Amsterdam, 1964, p. 183.

Another point to be considered in assessing the practical value of this concept is that it is based on various assumptions which are not very realistic. First, it assumes that output and income are determined by production capacity and its utilisation; productive capacity in turn is assumed to depend exclusively on the level of net investment and technical progress. The second assumption is that any addition made to the stock of capital, and therefore productive capacity, is from the outset utilized to the same degree as already existing capacity. When a capital equiptment has been in use for sometime it gradually reaches the limits of its full potential, but when it is newly installed it is unrealistic to assume that it would be operated as intensively as the older ones. Yet this assumption has to be made; otherwise the relationship between output and capital will not be uniform over time. Third, it is assumed that labour supply is elastic which means that the full utilisation of machinery and other capital equipment is not held up because of shortage of labour. This, obviously is possible only if there is a surplus of the labour force which decreases as capital is used in the course of the plan period but which is not fully exhausted.[1]

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*Kindleberger, Charles P., *Economic Development*, McGraw-Hill, New York, 1958, p. 43.

[1] Litsowski, Witold, "Capital-Output-Employment Ratio", Pergamon Press, Oxford, 1965, p. 6.

The relationship between capital and output is in a large measure determined by technical factors. Yet the ratio under the ideal conditions is scarcely the same as one that actually prevails. This is because of the many variables which affect its value. Technological improvements, better utilisation of equipments, improvement in organisation, labour skill and methods of production, changes in demand and prices, climatic conditions, all these affect the size of output. The experience in India in the First Plan period is illustrative of this uncertainty. The overall ratio for the economy in the plan period was assumed to be 3 : 1. But the large yield in agriculture which was due in a great measure to favourable climatic conditions brought down this ratio to 2 : 1. The variables involved are not only not measurable but their behaviour also cannot be foreseen.

Normally, the value of capital in developed economies is estimated to be about two to three times the national product. In any particular economy, however, the ratio depends on various factors. To the extent inventories as working capital are included on the side of capital, the proportion of output will vary inversely to the size of inventories, fixed capital remaining constant. It is also obvious that the ratio of output to capital depends directly on the extent to which existing capital is utilized. Capital in the form of machines is better and more fully utilised if instead of one shift, double shift is introduced; this would, of course increase the depreciation of the capital equipment, but even if capital depreciates twice as fast as when there is a single shift, the productivity flow will be greater than the rate of depreciation. Thus in a period of depression when there is underutilisation of capital because of lack of effective demand, the ratio of capital to output rises.

Since the overall capital-output ratio of the economy depends on the ratios of the individual sectors, any shift in the relative importance of the different sectors or the introduction of capital saving or capital intensive techniques in particular enterprises or sectors will directly affect the overall ratio. Thus a shift in emphasis from agriculture and light industries to capital goods and heavy industries raises the ratio. In the same manner, the ratio of capital to output rises if in particular sectors the technique of production is changed involving increased use of capital. Apart from capital structure, the ratio is affected also by the time taken by investments to mature. If the investment takes a long time to mature, the capital-output ratio will tend to be high. Even when the techniques and capital structure remain unchanged, the ratio of capital to output will change and fluctuate because of price variations. Capital-output ratio rises and falls with variations in the cost of the inputs—the wage rate, rate of interest and prices of raw materials. Where capital equipment is imported, a rise in the cost of the equipment raises the ratio. On the other hand, if import restrictions are severe, it is likely that the existing equipment will be used to its maximum capacity in which case the ratio will decline. Lastly, the availability of external economies and the utilisation of by-products would lower the ratio. Thus the development of social overheads and public utilities increases the yield of capital in the other sectors of the economy which benefit by such facilities. It is also possible that the expansion of one industry would have a favourable effect on other industries and help in bringing down the ratio of capital to output of these industries.

In planning models (sectoral as well as overall) the ratio of capital to output is assumed to be approximately fixed. From what has been stated above it is clear that this can be true only if the minor variables are insignificant or move in such a way that they cancel out one another. This is brought out succintly by Prof. Reddaway:

Let investment in a particular sector in a given period be x. Add to this capital expenditure on modernisation, M, and plus or minus an adjustment for time lag L between the date when expenditure is incurred on construction and completion.

On the sides of output, its size is determined over and above addition to capital, by (a) better methods of operating existing plant. This may be called 'progress' and denoted by P; (b) changes due to fuller utilisation of plant because of changes in demand D; (c) changes due to introduction of double shifts, etc., S; (d) and changes due to better weather, W. If the capital cost is x and the capital-output ratio in a new productive unit is r then the increase in annual output $= \frac{x}{r}$

Then the observed capital-output ratio is

$$\frac{X+M+L}{\frac{X}{r}+P+D+S+W}$$

Stated in this way, the actual capital output ratio will be approximately equal to r only if M, L, P, D, S and W were all small in relation to x or if they move in the same direction uniformly to the same extent or behave in such a manner that the gain in one is just offset by decline or loss in another. In that case the determining factor will be the scale of investment, x[1].

Moreover, capital-output ratio does not indicate what the actual contribution of capital alone will be in a given scheme of investment. In making a decision with regard to investment in any enterprise, the planner or the entrepreneur has to weigh the cost against the returns. The cost of capital or the interest to be paid will be found worth incurring only if the contribution of capital is known. It is the marginal product of capital that is equated with interest. In so far as the capital co-efficient indicates the extent to which returns would increase if the supply of capital along with other factors is increased, it does not help in making any decision with regard to the scale of investment. Further, the capital-output ratio does not indicate the extent to which other resources are to be increased in combination with capital. Given the technique of production, it assumes that when the amount of capital is varied, the other factors are also to be varied proportionately. The requirement of other factors can be known only if the production function is known. And if the elasticity of supply of the other factors is limited, greater weight will be given to the relative cost of these factors than to capital in investment decisions. In other words, the attractiveness of a low capital-output ratio cannot by itself influence investment decisions; nor would a high capital-output ratio shift investment from capital intensive to capital light enterprises. The choice of techniques in such cases would have to be made on other considerations.[1]

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[1] Reddaway, W.B., *Development of the Indian Economy*, George Allen and Unwin Ltd., London, 1963, Appendix, p. 208.

Production Function—An Alternative

The limitations of the capital-output ratio have led, of late, to a reaction in favour of the production function as a better means of measuring the capital requirements of growing economies. According to the Cobb Douglas production formula, product is the function of labour and capital: $P=f(L, C) = bL^{k}C^{1-k}$. In this formula constant returns are assumed; k and 1—k are the Labour and Capital co-efficients and b is a constant. For the period 1914-22 in the USA b is given a value of 1.01 and k is assumed to be 0.75. Hence $P=1.01L^{0.75}C^{0.25}$. Thus according to this formula increase in the supply of capital by 1, raises output by 0.25 and a similar increase in labour raises output by 0.75. Similar estimates have been made for India, Divatia and Trivedi calculated the values for Indian manufacturing industry in the year 1938-39 as $P=12.17$, $L^{0.402}C^{0.598}$ and for 1948, Bhatia estimated the figures at 0.67 for labour and 0.26 for capital.[2] Tinbergen points out that capital per head figures are better than capital-output ratios in certain cases insofar as for a given country the number of persons to be employed is known whereas the quantity of product is not known beforehand but has to be made as high as possible.[3] Prof. Eckstein remarks that "statistically these functions explain the historical changes in output with astounding precision and unless the economic structure changes, the aggregate production functions should do very well better than the incremental capital output ratios.."[4] However, a correct estimate of the production function in low income countries is as difficult as it is to calculate the capital output ratios, and unless the production function is worked out with greater precision it cannot be used extensively in investment programming.

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[1] Rosen, George, *Industrial Change in India*, Asia Publishing House, Bombay, 1959, p. 38.

[2] See Clark, Colin 'Conditions of Economic Progress', Macmillan, London, 3rd edition, 1957, pp. 589-591.

[3] Tinbergen, Jan., *The Design of Development*, Johns Hopkins, Baltimore, 1958, p. 72.

[4] Otto, Eckstein, 'Capital theory and some theoretical problems in Development Planning', *American Economic Review papers and proceedings*, May 1961, p. 97.

Disparity in the Ratio

Estimates have been made about the capital ratios in various countries of the world, both developed and under-developed. These show considerable disparities not only between the rich and the poor countries but also among the two categories themselves. Even in the case of the same industry the ratio varies from country to country. Estimates made some years ago show that in the case of a few agro-industries the ratio was higher in India than in some of the highly industrialised countries. Also, the ratio is high in India for a normally capital intensive industry like Iron and Steel compared with that of Canada. It may be plausbile to argue that in respect of bigger manufacturing industries the ratio tends to be high in the initial stages in poorer countries because of the costliness of imported equipment, lack of adequately trained personnel to operate the machines, lack of proper maintenance of equipment and probably under-utilisation of the capital equipment. However, in course of time as the industry gets well established, many of these difficulties disappear, capital gets fully exploited and the ratio tends to come down even below that of richer countries because of cheapness of labour, availability of materials, etc.

Variations in the estimates are due partly to the methods of computation as for example the components included on the capital side—whether inventories or working capital are included or excluded—and partly to the economic circumstances and the institutional and organisational patterns characterising each country. But it must be observed that even a small change in the ratios will have a magnified effect on capital requirements and the incremental output resulting from investments. Thus Rosen points out that if a ratio of 3 : 1 is computed with a margin of error of 1/3 on either side of the ratio, then the range within which the ratio actually falls may be 2 : 1 and 4 : 1.

This means that the rate of return of capital as measured by the ratio falls between 25 per cent and 50 per cent. And this is a difference of 100 per cent in the rate of return.[1] Again if a figure of 3.0 for the capital output ratio is used when 4.0 proves to be the correct one, the rise in output comes to be over-estimated by 32 per cent after one year and by rising percentage thereafter, if the rate of the investment depends on the increase in output.

These limitations of the capital output ratio underline the need for extreme caution in making use of it in the formulation of investment policy. It is worth repeating that this concept as distinct from the concept of marginal productivity of capital does not establish that a given rise in the level of investment would inevitably result in a certain increase in output. The ratio does not imply a causal theory; it indicates only a statistical association between investment and output.[2] However, it reflects broadly the social productivity of capital. The ratios relating to particular industries or sectors of the economy give an idea of the degree of capital intensity required in different enterprises and enable a preliminary estimate to be made of the investment required to obtain a given income increase. As such, in the absence of other reliable data it is indispensable if some notion is to be had of the possibilities of putting the various alternatives into practice.[3] Given the supply of capital resources in an economy, even a rough measure of the capital requirements of different industries helps in allotting priorities to the different lines of investment. Moreover, the trends in capital output ratios pertaining to particular sectors and to the economy as a whole over time provide an insight into the trends in the required factor combinations. This helps in an assessment of the extent to which particular resources or factors are to be increased to maintain a given rate of growth of the economy.

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1. Rosen, George, *Industrial Change in India*, Asia Publishing House, Bombay, 1959, p. 40 f.n.

2. Economic Bulletin for Asia and the Far East, U.N., No., 1955, p. 26, f.n.

3. Analysis and projections of economic development, U.N., 1955, p. 22.

Trend in the Ratio

Although several factors affect the quantitative relationship between investment and output, yet it is interesting to note that the overall ratio in some of the developed countries has remained fairly constant over a long period of time. According to a calculation made by Simon Kuznets, the ratio of net fixed capital and inventories to net national product in the USA was around 3.5: 1 in the years 1889 to 1944, the range of variation being 2.99 : 1 in 1889 to 4.03 in 1934. The latter figure however has no great significance as it relates to the depression period. Excepting this, the maximum was 3.86 in 1929.[1] This constancy must be due to various interacting forces. Thus the gradual decline in interest rates over this period and diminishing returns operating in the advanced countries should have tended to pull the ratio in the upward direction, while technological progress and improvement in labour skill and external economies would have operated in the opposite direction.[2] Apart from this, inter-industrial shifts would have also contributed to this stability. While the ratio tended to rise in agriculture, mining and manufacturing, it declined in the transportation and public utility sectors. Another factor is that the annual increments to capital would be too small to have any appreciable effect on the ratio. Domar points out that if capital growth is at the rate of 3 per cent per year and if output is assumed to be completely constant it would take 23 years for the aggregate capital co-efficient to double.[3] But since income is also increasing at the same rate and increase in income necessitates a corresponding increase in the demand for capital, the capital output ratio is bound to be stable.

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1. Domar, Evsey, 'Interrelation between Capital and Output in the American Economy, *International Social Science Bulletin*, UNESCO, Vol. VI, No. 2, 1954, p. 238.

2. Bruton, H.J., 'Growth Models and Underdeveloped Economies; *Journal of Political Economy*, August, 1955. Reprinted in Agarwala, A.N. and Singh, S.P., (Eds.) *Economics of Underdevelopment*, Oxford, India, 1958, pp. 224 and 225.

3. Domar, Evsey, 'Interrelation between Capital and Output in the American Economy', *International Social Science Bulletin*, UNESCO, Vol. VI, No. 2, 1954, p. 241.

A review of the trend in the capital output ratio figures of U.K. and USA reveals a great similarity in pattern. In both the countries the ratio shows a very gradual rise since the last quarter of the 19th century to the twenties of the present century. With the exception of a sharp rise in the depression period (1930s) which, however, is due to special circumstances, the ratios in the two countries show a general downward trend up to about the middle of the century. Since then, there has been an appreciable movement upward. In the U.K. over the years 1870 to 1900 capital inreased at the same rate as income; per capita real income and capital per head increased by about 40 per cent in 25 years; in 1895 to 1913 capital per head continued to rise, while real output per head remained more or less constant; between 1924 and 1938 real output rose substantially more than the stock of capital, thus bringing down the capital-output ratio.[1] It would therefore appear that in both these countries there was a considerable step up in investment in capital intensive enterprises in the first quarter of the present century. Since then, and up to recent times, a relatively low rate of capital accumulation was accompanied by the adoption of new techniques of production, the scope for the full utilisation of which increased in the course of years. Investments in heavy capital-intensive enterprises such as public utilities, transport and railways, tend to be lumpy at certain periods. At such stages the capital-output ratio rises. But with the passage of time, as they come to be fully and better utilised, the ratio of capital to output tends to decline. Adoption of capital-saving inventions in later years, external economies, improvement in organisation, skill and knowledge of labour also helped in an increase in output without a corresponding demand on capital. The rise in the ratio in recent years should be attributed so the large investments for building up the economies after the ravages of war and for the replacement of equipment worn out by overstrained working during the war and also to the new drive to increase productivity of labour by raising capital available per head with a view to improve the economic and political strength of the nation.

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[1] Phelps Brown, E.H. and Bernard Weber, 'Accumulation, Productivity and Distribution in the British Economy, 1870-1938, *Economic Journal*, London, June 1953, pp. 263-88.

Likely Trend in Developing Countries

What the actual capital-output ratio would be in under-developed countries in the early stages of growth, and what its trend would be as the economy progresses, appear to be, by and large, a matter of guess work. Among the forces which tend to push up the ratio may be mentioned the following. Firstly, economic development of present day under-developed countries which have stagnated for centuries in a state of under-employment equilibrium is possible only if very heavy 'lumpy' investments are made for the provision of social overhead facilities—improvement of means of communications, construction of roads and railways, hydro-electric schemes, establishment of financial and banking institutions, development of ports and harbours, etc. To the extent such large investments have to precede industrial expansion, and in so far as the external economies from such development projects would take much time to fructify, the capital-output ratio in the initial stages is bound to be high. Secondly, (and this also emerges from the fact that under-developed countries are late in the race for economic development) the low income countries have to import technology and capital equipment from industrially advanced countries. With scarcity of labour and abundance of capital, the technology and capital goods developed in the advanced countries are generally always of the capital-intensive type. Insofar as the poorer countries are incapable of developing a technology suited to their own factor endowments, they have to import such costly equipment. Since skilled labour is lacking, management is unsatisfactory and the maintenance of capital goods defective, it would not be possible to operate the capital goods efficiently. All these would make the ratio of output to cost of capital small. It has also been mentioned that in the early stages of growth, when the income of the people rises and conditions of life improve, there will be a tendency on the part of the people to demand costlier manufactured consumption goods which are the products of capital intensive industries. Fuller exploitation and possible exhaustion of non-reproducible wealth such as mineral and other sub-soil resources, would necessitate importing of materials from abroad or the production of synthetic substitutes all of which add to the investment and cost of production and raise the capital-output ratio. Lastly, urbanisation which goes hand in hand with industrialisation would necessitate large investments in urban house construction and the provision of other amenities and add to the cost side of capital.

The experience of present day developed countries in a corresponding stage of their economic growth lends support to the view that capital-output ratio will rise in the early stages of development. On the other hand, some valid points are brought out to substantiate the view that in the backward economies, even if the ratio is high to begin with, it would rapidly come down. Although the initial investments may be heavy, in process of time the capital stock would be better utilised. There would be improvements in the skill of labour as well as of management, better experience in the handling and maintenance of machines, and as a result, the output per unit of capital invested will rise. Further, their lateness in economic development helps the pre-industrial countries, in so far as they can import up to date technology from the advanced countries, to skip the long period of costly experiments and research in technological innovations. It is also reasonable to expect that the poorer countries of today with factor endowments different from that of the industrial countries would in course of time be able to adapt technology to suit their resources position and so would be able to produce capital goods of a cheaper variety requiring greater quantity of labour to work with. Such a process will be facilitated by the increasing scope for closer contacts with richer countries, greater ease in the communication of ideas and the dispersal of technical knowledge and skill. Perhaps the easier flow of technical information and knowledge from developed to underdeveloped countries is the most decisive factor in not only accelerating the pace of economic growth in the latter, but also in enabling them to evolve techniques of their own, and stand on their own legs. The increasing attention devoted to public health, education and technical training would raise the productivity of labour and thereby help in a great measure to increase national output without any proportionate increase in fixed capital. Also, when development gets underway, various external economies would arise and industries in which no additional investment is made would benefit by the expansion of some key major industries and public utilities. Colin Clark mentions the point that economic growth would involve the expansion of the tertiary sector which is relatively capital-scarce as compared with the secondary or industrial sector and as such with every increase in the proportion of labour engaged in the tertiary industries, capital requirements will decline relatively.

It would thus appear that the forces tending to raise the capital co-efficient in under-developed countries are balanced by opposite forces which would reduce it. Hence it would be hazardous to make any definite conclusion regarding the behaviour of capital co-efficient in developing economies. The actual trend depends upon the specific forces at work in any particular country, its factor supply situation, the economic conditions under which growth takes place, the pattern of economic and industrial development which the country adopts, its contact with advanced economies, the skill, efficiency and aptitudes of its people, etc. In respect of India, after reviewing the factors affecting the capital co-efficient, Coale and Hoover make the cautious remark that "there appears no ground to expect an unusually high ratio and a fair presumption for expecting the ratio to be rather on the low side in the near term future as compared with the ratios of 3 : 1 and higher in developed countries". They however add that as development proceeds, the ratio is likely to rise.[1] As the economy develops, there will be need for increased investment in housing and other welfare categories. But while the need for increased housing facilities is great in India, the fact that cost of construction and standards are lower would prevent the capital co-efficient rising higher because of this factor. On the other hand, investment in transport, communication and other economic and

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[1] Coale, A.J. and Hoover, E.M., *Population Growth and Economic Development in Low Income Countries*, Oxford, India, 1959, p. 233.

social overheads requires a large amount of capital. And although unlike in many other low income countries much of these overheads is already available in India, they are strained to their capacity and there is need for fresh investments on a substantial scale. Against this, the possibility of importing capital saving technology from the advanced countries and the fact that there is great scope for the economising of capital in the agricultural sector and in handicrafts and small industries would lower the ratio. This possibility is particularly great in agriculture which constitutes an important segment of the economy and accounts for about 25 to 30 per cent of the total growth of output in the country. The present ratio in agriculture is supposed to be about 1 : 1 and the scope for expanding agricultural output through labour-intensive methods would be a major factor in keeping the overall capital-output ratio low.

But on the whole it appears that the forces tending to raise the capital co-efficient in India are stronger than those working in the opposite direction. In general, so long as emphasis is laid on industrialisation, hydro-electric projects and the development of social overheads, investment is bound to rise rapidly without, in the initial period, yielding any corresponding increase in output. It would take a fairly long period of time before this preliminary phase of preparing the ground for growth can be completed. To this should be added the tendency towards greater capital intensity in Indian industries observed by Rosen. His view is that the effect of government policy in recent times has been both to raise labour costs directly in terms of higher wages and amenity costs and to reduce greatly the area of manageability of labour. This rise in labour costs combined with the competition of government plants has forced the private firms to introduce more capital intensive and labour saving equipment.[1] It would thus be seen that the chances for the capital-output ratio in India to come down in the next two or three decades are very limited.

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[1] Rosen, George, 'Capital-Output Ratios in Indian Industry', *Indian Economic Journal*, Bombay, October, 1956, pp. 107-21.

APPENDIX

Estimating Capital-Output Ratios

Although the theoretical limitations of the concept of capital-output ratio are many, and its practical value has quite often been questioned, yet it continues to be commonly used in exercises related to practical planning. Since investment for development purposes represents an addition to existing capital ($I_t = A\ K_t$) reliance is placed usually on the incremental capital output ratio rather than on the average ratio. Excepting in rate instances where an altogether new industry is to be started, in which case the average and the marginal are the same, ICOR serves the purpose more or less satisfactorily. To say the least, it gives a rough idea of the magnitude of investible resources required for achieving the targets of production set in the plan. And this is important, for otherwise, the planner would have to rely exclusively on his intuition and judgement and on past experience concerning the expansion and income growth of each sector of the economy.

The basic data required for computing the ratios for the different sectors of the economy and for the economy as a whole are the following:

(i) Net domestic product at factor cost in the aggregate as well as for the different sectors at constant prices for a continuous period of 5 to 10 years.

(ii) Net investment, sectoral and aggregate, for the same period at constant prices.

(iii) Computation of the ICOR for the relevant period on the assumption of a one year lag between investment and output.

It should be noted that the classification and groupings of the various sectors of the economy adopted in government publications for presenting income data are different from that indicating plan outlays in the plan documents. The first thing to be done, therefore, is to regroup the income heads so that they match with the investment or plan outlay heads. Tentatively, and for purposes of illustration the following major heads may be identified:

1. Agriculture
2. Mining and manufacturing
3. Power
4. Transport
5. Social Services including housing and inventories.

National income figures, aggregate as well as sectorwise are available in the CSO white paper as well as in other government publications. The estimates have to be made on the basis of time series for a period of, say, 10 years. The figures are to be expressed in constant prices, taking a particular year as a standard or base year.

It is in the compilation of investment figures that difficulty arises. Total investment is made up of investment in the public sector and investment in the private sector. Plan outlays for the different sectors are shown in the plan documents but in order to find out the plan investment, it is necessary to deduct 'current outlays' from plan outlays. Estimates of the current and capital outlay components have been made by the Economic Division and the Programme Administration Division of the Union Planning Commission and these can be made use of for the present purpose. It is seen that the investment component forms on the average about 85 per cent, and current outlay about 15 per cent of total plan outlays.

The data for investment in the private sector is meagre and unsatisfactory. Attempts to compile data relating to private investment have been made by the Reserve Bank of India, the National Council of Applied Economic Research and the Planning Commission but the figures show appreciable differences. It is, therefore, necessary to work out approximately reasonable figures on the basis of certain assumptions and by piecing together information from various sources. The figures arrived at in this manner can however be checked up by data relating to private sector savings and inflow of foreign resources to the private sector net of transfers to the government. The main source of information for this item as well as for corporate savings is the Reserve Bank studies and publications. Corporate savings plus household savings in the form of financial and physical assets constitute the total quantum of private savings in each year. Deducting from this the draft of the public sector on private savings, the total private investment for each year is arrived at.

This total amount has to be apportioned among the various sectors. Studies made by the Reserve Bank of India of company finances and the pattern of investment in the Corporate Sector, and investigations made by the same institution concerning the proportion of sectoral income as well as national income getting invested in agriculture and rural housing and the calculations made by the Planning Commission in respect of small industries and transport provide guidelines for purposes of this allocation.

All these figures are to be deflated and reduced to constant prices. Income figures in current and constant prices are readily available but as regards investment goods, current price series have to be converted to the prices of a particular base year by constructing investment cost indices on the basis of (a) the prices of major inputs entering investment such as cement, steel, bricks, timber, indigenous plant and machinery, imported plant and machinery and construction, labour and other services, and (b) the relative weights of different materials and services in total investment and investment in particular sectors.

Finally, before working out the capital output ratios the trend values of income change have to be estimated. Aggregate investment over the years may show an increase or decrease in any particular year. Decreases are however, exceptional; but they are all positive in the sense that even when investment in a particular year is less than in the previous year, it represents a net addition to the capital stock. In other words, capital stock is increasing from year to year over a series of years; correspondingly, if a comparison is to be made between income growth and capital growth, income figures should show a steady rise. However, it is likely that in respect of some sectors the difference in output in certain years compared with the preceding year is negative. In order to eliminate or reduce such fluctuations and also to have an overall picture for a number of years, trend values of income are to be calculated by fitting trend curves of the form.

$Y_t = ab^t$, where t is the time interval and a, and b, are constants.

Having estimated the total investment and the total output at constant prices for the different sectors for the years under consideration, the ICOR for each sector can be computed by using the formula,

$$(\text{ICOR})_i = \frac{(\text{I}_{t-1})\text{i}}{(\text{Y}_t - \text{Y}_{t-1}\text{i}}$$

Where i stands for the i^{th} sector; I_{t-1} investment in the $(t-1)^{th}$ year and Y_t income in the t^{th} year.

On the basis of the trend estimates of income, the increase in income in each year is determined. Allowing a time lag of one year as between income and investment, the increase in income in the t^{th} year in a particular sector is related to the investment made in $(t—1)^{th}$ year in the corresponding sector and the ICOR for that sector is worked out.

The combined ICOR for all the sectors is estimated using the relation $B = K_1B_1 + K_2B_2 + \dots K_nB_n$ where K_r is the proportion of investment in the sector to which it relates to total investment $O < K < 1$ and B_r (r, 1...n) is the reciprocal of the ICOR of the r^{th} sector. This is illustrated below:

SECTOR	*Proportion of investment to total investment average for all the years.* K_r	*ICOR*	*Reciprocal of ICOR* B_r	$K_r B_r$ *Col. 2×col. 4*
1	*2*	*3*	*4*	*5*
A.	0.2	1.87	0.54	0.108
B.	0.4	5.45	0.18	0.072
C.	0.3	14.66	0.07	0.021
D.	0.1	2.63	0.38	0.038
	1.0			say 0.24

The combined ICOR for the four sectors is the reciprocal of 0.24 (sum of figures in column 5) i.e., 1.00/0.24 or 4.2 or roughly 4 : 1.

CHAPTER VIII

The Tools of Economic Planning– II. Cost Benefit Analysis

I. THE THEORETICAL ASPECT

The purpose of Cost-Benefit analysis is to help the planner or the policy maker in choosing between alternative projects of development on the basis of an evaluation of their relative costs and returns. Since resources are limited there is always the problem of choice in the matter of making investment decisions. Investment means utilising resources available at present for the construction or development of a project—an industry, a hydro-electric project or the construction of a road or a school—which is expected to yield returns over many years. Investment, therefore, implies the foregoing of present consumption in order to increase future consumption. Thus in assessing the benefits and costs of a project, we are actually comparing the value of present consumption with that of future consumption.

This problem of choice has to be faced by both the private entrepreneur and the State. In the case of the latter, however, the problem becomes much more complicated because of the manifold objectives and the much longer time perspective which the State should have in view. The State's concern is not so much making the project commercially viable as to make it yield the maximum net social returns. The objective of the State may be to raise the standard of living of the people, to bring about more equitable distribution of wealth and income, achieving full employment, eradication of poverty, ensuring a higher rate of growth of national income, building up a self reliant economy, or promotion of social welfare by investment in education, public health, etc. In all these cases the objectives may be well defined but it is difficult to relate the costs involved to benefits arising from investments in particular projects.

Direct and Indirect Costs

So far as costs are concerned, an estimate is to be made of direct as well as indirect costs. Costs of construction are obviously of the direct kind. We have to take into account not only the costs incurred at the construction stage, but also that arising after construction when the project is in operation (operation period). For both periods, the value of the inputs—raw materials, semi-finished products, energy, imports and labour of various skills—required for the project has to be worked out.

Apart from the above mentioned items of cost, the indirect costs of a project are also to be estimated and included in cost benefit analysis. What is to be done here is to assess the external effects that result in a net loss to society. A typical example is the pollution of air or water caused by industrial plants. The discharge of these plants is a by-product of the industrial process which adversely affects the surrounding population. In such cases, there is a loss borne by the society which ought to be set against the returns of a project.

Direct and Indirect Returns

As in the case of costs, benefits also can be of the direct and indirect type. The usual approach to estimate direct benefits is firstly, through the market value of output produced, and secondly, through the cost of producing the same output in some alternative manner. The first is possible only when the output is a priced commodity or service. If not, the latter method is to be used. The gross benefit resulting from output marketable under conditions of pure competition would equal market price times quantity of output. If electricity is made available to an agricultural area and this results in an increase in grain production, this may be regarded as a direct primary benefit. The benefit here is in the form of goods and services which are the objectives of the project.

Secondary and indirect benefits arise as a result of the economic consequences of a project. Introduction of electricity in a village may have the objective of increasing agricultural production, but if some industries are started and these industries supply cheap materials to another industry in a neighbouring area, the cost of production of the latter comes down and it may reap larger profits. These are indirect benefits of that industry. Further, increase in agricultural production results in higher incomes for the people of the village whose demand for consumption goods like textiles, and services like cinema, increases. Hence, the textile and cinema industries benefit. This is an economic as distinct from a technological indirect effect of increased electricity supply.

Estimating the Present Value of Future Costs and Benefits

The purpose of cost benefit analysis is to rank the various projects according to the excess of benefits over costs of each so as to help the planners or the government, to choose a few, given the resources constraint. Assuming that the benefits and the costs can be given a monetary value, it is possible to sum up all the benefits that may be derived from, and all the costs that will have to be incurred on a project over its life time. But since the investment has to be made at the present time or current year, it is necessary to find out the position as it now obtains. That is to say, if the costs and benefits are to be made comparable both will have to be expressed in present value terms.

This necessitates discounting of future values. A sum of Rs.100 available 10 years hence, will be of less value than Rs.100 at the end of 5 years, which in turn will be less valuable than Rs.100 available now. In other words, the value of the same amount of returns arising every year over a period of years will be steadily declining with every successive year. The value decreases as follows:

$$B^* = B_0 + V_1B_1 + V_2B_2 \ldots V_TB_T$$

B^* is the present value. B_1, B_2, etc., are values of future returns, V_1, V_2, etc., are weights expressing the rate at which value is decreasing. B^* is called the discounted present value of aggregate consumption in future years. The problem is how to determine the weights V_1, V_2, etc. Usually for purposes of this sort of discounting, the current market rate of interest is used. If r is the market rate of interest, individual borrowers can be assumed to weight next years consumption by $\frac{1}{(1+r)}$.

The market discount factors will then be,

$$\frac{1}{1+r}, \frac{1}{(1+r)^2} \cdots \frac{1}{(1+r)^T}$$

Thus assuming r to be 5 per cent and the value of returns is Rs.100 every year, the present value of the sum of future returns is worked out as follows:

In the current year it is			Rs.100
In the second	,, ,,	$100 \frac{(1.00)}{(1.05)}$	= Rs.95
In the third	,, ,,	$100 \frac{(1.00)^2}{(1.05)}$	= Rs.90
In the fourth	,, ,,	$100 \frac{(1.00)^3}{(1.05)}$	= Rs.86
In the fifth	,, ,,	$100 \frac{(1.00)^4}{(1.05)}$	= Rs.81

A project is ranked according to the ratio of its cost to the discounted value of its future returns. At the installation stage of a plant, initial capital expenditure is incurred. After operation starts, there will be recurrent expenditure, but there will be returns also—the former may be financed out of the latter; hence net returns alone need be taken into account.

For illustration, we assume that the initial capital outlay of a project is Rs.500 lakhs

Recurring costs (maintenance, administration, etc.)	Rs. 8 lakhs
Annual returns	Rs. 15 lakhs
Net annual returns (15—8)	Rs. 7 lakhs

The discounted value of future net returns (for a given number of years) say Rs.620 lakhs

Benefit cost ratio $\frac{620}{500} = \frac{6.2}{5} = 1.24{:}1$

The Internal Rate of Return

The present discounted value of returns helps in the ranking of the projects and in choosing those which are more attractive than others. If only one is to be chosen, naturally that project with the highest present value will be selected. But the point against discounted value is that it is based on a given discount rate which is the interest rate. And the question is, why should the value of investment be made to vary according to market interest rate which is an external factor and which is determined by other conditions?

In order to get over this difficulty, an alternative approach based on what is called the internal rate of returns is made use of. Internal rate of return is that rate which when applied to all future returns will make their sum equal to the present capital outlay. A simple example will illustrate how the internal rate of return is calculated. Consider a stream of net benefits – 100, 50, 86.4 where—100 represents the initial capital outlay (The minus sign indicates that the figure comes on the cost side). The present value of returns in the first year, namely, 50 discounted at 20 per cent is $50/(1+0.2)$ i.e., 40 and the present value of 86.4 obtained in the second year is $50/(1+0.2)^2 = 60$. The present value of the returns for the two years is 100 which is the same as the capital cost of 100, i.e., 100. Twenty per cent which equates the present value of the positive net benefits to the present value of the net outlay is taken to be the internal rate of return of the above stream of net benefits. A project is preferred according to this rate; the higher the rate, the more preferable the project.

The internal rate of return may therefore be defined as that rate (P) which sets the present value of the project at 0. The net returns stream $R_0, R_1 \ldots R_T$ for the finite time horizon T is common to both the present value and the internal rate of return criteria. However, instead of computing the present value V_0, given r, as in the present value criterion, the internal rate of return criterion solves for P (given a present value of zero).

$$\text{i.e., } 0 + R_0 + \frac{R_1}{(1+P)} + \frac{R_2}{(1+P)^2} + \ldots + \frac{R_T}{(1+P)^T}$$

Though the internal rate of return is a useful concept, yet it is subjected to criticism on three grounds. First, the rate of return calculations may not give a unique answer and in fact may give as many solutions which could have economic meaning as there are sign changes in the stream of net returns. There will be as many positive solutions to P as there are changes in signs in the values af successive net returns R. If we assume (1) that R_0 is always negative, (2) that there is at least one subsequent R that is positive, and (3) that the final R is negative (for example, bacause disposal costs exceed scrap value) there will always be a minimum of two positive solutions (it may be noted that in this example there are two changes; from negative to positive and from positive to negative) for P, and thus ambiguity will almost always arise when the internal rate of return is utilised in such situations.

Second, in the case of mutually exclusive projects the internal rate of return may lead to wrong ranking as is shown in the illustration below:

	Stream	*IRR*	*PV at* $r = 0.05$
A	-100, 110	0.10	5
B	- 10, 12	0.20	1.5
C	-100, 6, 6 (forever)	0.06	20

Of the three projects A and B are of different sizes; A and C are of the same size but of different lengths. According to IRR ranking, B is preferable to A but according to present value criterion A is preferable to B. Also, according to IRR criterion the longer stream C is less attractive than A which is shorter, but the present value of C is much greater than that of A.

Further, the internal rate of return also depends, at least indirectly, on a notional rate of interest. The criticism against present value is that it is influenced by the interest rate which is an external factor. The internal rate of return is not free from this limitation either. For though the rate of returns can be calculated independently of the rate of interest, yet, whether it is high or low is determined with reference to some standard rate such as the bond rate.

Problem in the Estimation of Costs and Benefits

The basis of cost benefit analysis is valuation; valuation of all items of costs and all items of benefit. For estimating both costs and benefits the investigator should know the price of the goods and services. In order to arrive at the present value of the future returns from an investment, a rate of interest has to be made use of. Wage rate or price of labour and foreign exchange rate which again is a price at which domestic currency exchanges for foreign currency also form important elements of cost.

In an ideal free enterprise economy where there is perfect competition marked by homogeneity of products, perfect mobility of factors of production, perfect knowledge of prices, and availability of products and services, the price mechanism will function in such a way that there will be optimum utilisation of resources and maximum returns for every firm and industry. The price in the market will be the equilibrium price that equates supply with demand. Thus the price of a commodity will be equal to its marginal cost which will be equal to the average cost. Interest rate will be such as to balance supply of loanable funds with demand for loanable funds, and the wage of labour will be equal to its marginal product. Free market forces would determine foreign exchange rate which will reflect the true value of domestic currency in international markets. Any excess in supply or demand will result in relevant price movements which would restore equilibrium.

But between this ideal and the actual conditions in the market it is a far cry. Prices do not measure correctly the opportunity costs in respect of commodities and services, because of externalities, market imperfections, taxes, subsidies and government controls, the existence of unemployment both disguised and overt, collective goods (defence, anti-malaria programme, protected water supply, etc.) and the emergence of many intangible benefits. All these factors create problems in judging the benefits and costs on the basis of prices. Yet some sort of valuation is needed if a cost benefit analysis is to be done.

For this purpose 'shadow' or accounting prices are recommended. E.J. Mishan defines shadow price as the "price the economist attributes to a good or factor on the argument that it is more appropriate for the purpose of economic calculation than its existing price if any."[1] We need accounting prices for all categories of goods and services whose values are to be correctly assessed in order to make a realistic estimation of costs and benefits of a project. This would comprise : (a) prices of goods and materials; (b) Value of money used in connection with the project; i.e., interest rate; (c) Price of foreign exchange, and (d) money value of labour employed.

(a) Prices of Goods and Materials: R.N. McKean mentions different ways of deriving shadow prices.[2] One is to estimate it on the basis of the working out of linear programming models. The objective function in respect of a project in the model may be maximising production under certain constraints. This is the primal problem. For this a dual problem can be derived, the objective function of which will be minimising costs. The solution of this problem brings out a set of prices that will be appropriate for achieving the ideal of minimisation and these prices may be accepted as the accounting prices. The difficulty here, as McKean himself points out, is that programming methods have so far been found to be of limited value in making forecasts of economic variables and as such the shadow prices generated by such models cannot be considered reliable.

Another method of imputing prices is to take over price relationship observed in markets for similar items or in markets for the same items in other countries. But in reality there may be subtle differences as between apparently similar commodities in two markets or two countries. Hence, the same price is not applicable. Yet another means of deriving shadow prices according to McKean is to make use of market prices as the

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1. Mishan, E.J., "Cost-Benefit Analysis". George Allen & Unwin, London, 1971, p. 79.

2. McKean, R.N., "The use of Shadow Prices" in 'Cost Benefit Analysis', Ed. by Richard Layard, Penguin Books Ltd., Middlesex, England, 1972, pp. 119-139.

basis but to make corrections on this base so as to allow for the effects of externalities, changes in import restrictions, monopoly elements, subsidies, price support activities, etc.

A very significant contribution in this connection is the one made by Little and Mirrlees.[1] They distinguish between 'traded' and 'non-traded' goods—the first covers export and import goods and the second those goods which do not enter into international trade. For all internationally traded goods whether the country actually imports or exports, the price should be the foreign exchange equivalent, i.e., they should be valued at their c.i.f. (for imports) or f.o.b. (for exports). As regards non-traded goods, world prices have to be attributed to them taking into account the fact that of the various component items which go into the making of them, there may be some which might be of the traded variety. The value of these components may be determined in the same way as in the case of traded goods, and the proportion of the value of such components to the total value of the final commodity may be used for working out the world price of the commodity in question.

However, it is doubtful whether it would be possible in practice to make use of world prices as accounting prices in less developed countries in the manner suggested by Little and Mirrlees. Realising the difficulties, a recent writer feels that it is far simpler and sufficiently accurate to use:

1. world prices for the actually traded major capital and current inputs and for the outputs;
2. domestic factor costs (at either shadow or market prices as judged appropriate) for the non-traded inputs; and then to
3. convert these foreign and domestic values into a simple currency by resort to an exchange rate (again using any reasonable rate if the official rate is felt badly out of line).[2]

(b) Interest and the Discounting Rate: For assessing the present value of a project, its future returns are to be discounted at a certain rate; which rate is to be used is a subject of controversy. For investments by individuals as well as by firms, usually the current rate of interest which represents the opportunity cost of capital is recommended, but this implies that there is no capital rationing, i.e., that money for all purposes can be borrowed at the same rate of interest.

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[1] Little, I.M.D. and Mirrlees, J.A., "Project appraisal and planning for developing countries", Oxford and IBH Publishing Company, New Delhi, 1975.

[2] Baldwin, George B., "A layman's guide to Little-Mirrlees", *Finance and Development* (IMF and World Bank), March 1972, pp. 16-21.

In reality, the capital markets are not perfect. Even assuming that they are functioning perfectly, the market rate of interest is not suitable for discounting purposes for two reasons. Firstly, it is questionable whether the market rates of interest do bear any close relationship to the marginal productivity of investment and time preference. Secondly, the objection is raised that while market rate of interest may be suitable for estimating the present value of the future returns of private investment, it is not the proper one for discounting returns of public investment. The objective of the latter is to maximise social benefits and as such, social time preference is more relevant for fixing priorities among investment projects undertaken by the State.

Hence, alternative criteria are suggested for discounting future returns of public investment. One is Social Time Preference (STP) and the other is Social Opportunity Cost (SOC). A social time preference function assigns current values to future consumption, it reflects society's evaluation of the relative desirability of consumption at different points of time. This is a theoretical concept and unless it is specified by means of a formula its practical value is very limited. According to M.S. Feldstein who has put forward this concept, the STP function cannot be derived on the basis of existing market rates, but must be administratively determined as a matter of public policy.

A slightly more practicable method is suggested by Little and Mirrlees. They recommend taking up a few test projects which are already in existence and estimating their present value by assuming different rates of discount. Then, a particular rate which "in principle would have let through only a few of the best projects in the past" should be chosen as the accounting interest rate.[1]

Social Opportunity Cost (SOC) is a measure of the value to society of the next best alternative use to which funds employed in the public project might otherwise have been put. It would appear that government borrowing rate is a dependable measure of costs in so far as it can be regarded as the only risk free rate of interest. However, it is possible that if the same funds instead of being used by the government are employed by a private agency in a better way, the marginal product would be higher and hence the rate of interest paid by the government is not the ideal one for the purpose. In other words, the governments borrowing rate ts lower than what the marginal productivity of the capital would warrant.

In view of these difficulties it is suggested that for practical purposes reliance should be placed on actual rates. An appropritae rate among the rates ruling at the time may be chosen for estimating the project cost. Indeed no fine calculation is necessary in this regard, because any variation of the rates within a limited range, say, 4 to 8 per cent would not make much difference in the overall cost of the project. A United Nations study on this subject recommends that in a highly developed country a rate of discount of 6 to 8 per cent can be adopted while in a developing country the rate can be as high as 15 to 20 per cent.[2]

(c) Shadow Price of Foreign Exchange: Foreign currency is needed to procure foreign materials, and in evaluating a project, the value of foreign exchange used has to be expressed in terms of domestic currency. If the official exchange rate expresses correctly the real worth of one currency in terms of another, there is no problem. But this is not so. Therefore, shadow prices of foreign exchange (or an accounting foreign exchange rate) become necessary for evaluating projects.

The United Nations study on Project Evaluation gives details about one method of calculating shadow prices for this purpose.[1] According to this study, the shadow price of foreign exchange is basically a weighted average of the domestic market clearing price of the individual imports and exports relative to their world prices, the weights being the proportions of any additional unit of foreign exchange that would result in increased imports or reduced exports of the commodity in question. The illustration given in the study makes this clear. Suppose that as foreign exchange becomes available at the margin, it is used to import French Cognac at a c.i.f. price of FF 15 per bottle. Official exchange rate of 1 franc = 2 rupees. Hence at this rate 1 bottle of cognac at the official rate costs Rs.30. Assume it is scarce in India and fetches a price of Rs.45. Thus, the use of foreign exchange of FF 15 (at the official exchange rate of Rs.2 = 1 franc) permits the importation of a good the domestic value of which in terms of aggregate consumption is Rs.45. Thus, each rupee worth of foreign exchange provides foreign goods worth Rs.1.5. The shadow price of foreign exchange its thus Rs.1.5 per rupee.

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[1] Little, I.M.D. and Mirrlees, J.A., "Project appraisal and planning for develeping countries", Oxford and IBH Publishing Co., New Delhi, 1975, p. 294.

[2] "Guidelines for Project Evaluation", United Nations, New York, 1972.

The principle can be generalised to any number of commodities. Let f_i, be the fraction of foreign exchange allocated to the i^{th} of n commodities at the margin. And let P_i^D represent the domestic market clearing price, i.e., the price reflecting the marginal willingness to pay for the i^{th} import. Finally, let P_i^{cif} represent the c.i.f.. price in rupees calculated at the official rate of exchange. Then f_i/P_i^{cif} represents the quantity of the i^{th} import that will be purchased if an extra rupee of foreign exchange becomes available. For instance, if three tenths of marginal foreign exchange earnings are allocated to Cognac, then each rupee worth of foreign exchange will provide

$$0.30 \times \frac{1}{30} = 0.01$$

(*i.e. 30% or 0.30 multiplied by $\frac{f_1 \quad f_1 = \text{Rs. } 1}{p^{cif} \quad P_1^{cif} = \text{Rs. } 30}$)

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[1] "Guidelines for Project Evaluation", United Nations, New York, 1972, pp. 213-231.

bottles of cognac. In other words, it takes Rs.100 worth of foreign exchange to provide a bottle of cognac if only 30 per cent of foreign exchange is allocated to this commodity.

Consider that the quantities of good 1 . . . n,

$$\frac{f_1}{P_1^{cif}} \cdots \frac{f_1}{P_1^{cff}} \cdots \frac{f_n}{p_n^{cif}}$$

have the respective unit values

$$P_1^D, \ldots P_1^D, \ldots P_n^D$$

in terms of aggregate consumption. The total aggregate consumption value of the imported goods is therefore

$$P_1^D \frac{f_1}{P^{cif}} + \ldots + P^D{}_1 \frac{f_1}{P_1^{cif}} + \ldots + P_n^D \frac{f_D}{P_n^{cif}}$$

with $f_1 + \ldots f_1 + \ldots f_n = 1$.

This expression defines the shadow price of foreign exchange which may be denoted by P^F. Then,

$$P^F = \sum_{f=1}^{n} f_1 \frac{P_1^D}{P_1^{cif}}$$

Which shows that the shadow price of foreign exchange is a weighted average of the ratios of market-clearing to official c.i.f. prices, the weights reflecting the content of the marginal import bill.

(d) The Shadow Wage Rate: One important item of costs in a project is the wage bill. But the wage rate. which is the price of labour like any other price, is deceptive in the sense that it does not indicate correctly the supply and demand conditions of labour. This is particularly so in under-developed countries which are over-populated and where marginal product of labour is likely to be zero. But because of the pressure of trade unions and the 'softness' of entrepreneurs, labour is paid a wage which is much higher than its marginal product. In estimating the cost of a poject are we to compute labour costs by using the value of the marginal product of labour or the actual wage which the labourer gets?

Since neither of these is correct, the project analyst has to make use of an assumed rate as realistic as possible. This is called Shadow Wage Rate (SWR) or Accounting Wage Rate.

In estimating the shadow wage rate we have to take into account the direct contribution in the form of what the labourer adds to output in the project and also the indirect effect of his transfer on the income of others and on the distribution of income and savings. What has to be considered in this connection is the net social gain resulting from the employment of one more labourer, i.e., all the social benefits minus all the social costs. And the methods of estimating the shadow wage rate recommended by different writers are as many as the number of items of costs and benefits which they want to be included for computing the shadow wage rate.

Thus, Little and Mirrlees[1] draw a distinction between skilled and unskilled labour. Skilled labour may be traded or non-traded, i.e., skilled labour having an international market and that which is confined to the domestic market. As regards traded skilled labour, its value or wage rate is to be evaluated at world prices; but if it is non-traded skilled labour requiring further training for engagement in the project, the appropriate price of labour should take into account the marginal cost of this additional training, the income foregone by the individual who is undergoing training and a portion of the extra consumption (evaluated at world prices) that skilled labourers will demand over what they commanded before training. In the case of skilled labour that cannot be trained further, the appropriate price would be a wage rate that would divert the worker from alternative activities (opportunity cost).

In the case of unskilled labour in industry, the shadow wage is the opportunity cost of this labour (i.e., what it would get elsewhere say, in the agricultural sector) plus the social cost of the additional consumption. Additional employment will lead to additional income and also additional consumption which will have an effect on savings and investment; the presumption here is that since additional employment involves transfer of income from capitalists who are savers to wage earners who

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1. Little, I.M.D. and Mirrlees, J.A., "Project appraisal and Planning for developing countries", Oxford and IBH, Publishing Company, New Delhi, 1975.

are not savers, the net effect of this transfer will be a social cost in the form of lower savings and lower investment.

Prof. A.K. Sen makes a finer analysis of the same issue. The additional point that he brings in for consideration is that a transfer of labour from the peasant economy for working in a project results in a fall in the output of the rural economy.[1] If there is surplus labour in the peasant economy the fall in output resulting from transfer of labour from the rural sector to the project area will be zero; but if there is no such surplus the transfer would result in a positive loss. This loss is a cost and has to be set against the additional income obtained by the labourers who are transferred as well as of those who choose to remain behind in the peasant economy. In the latter case the rise in income is due to increased work effort of individual labourers because of the reduced number of workers. To this effect should be added the net increase in savings resulting from increased income of the project and of the individual workers. The sum of all these effects is the total change in welfare. If this change is denoted by U, then the optimal policy would be to expand the labour force as long as U is positive. Optimal position is reached when $U=0$.

The methods of estimating the shadow wage rate mentioned above make it clear that the conception of a shadow wage rate will remain vague so long as there is no agreement as to the various points to be considered in determining it. The fact is that we can say very little that is definite about the magnitude of the shadow wage rate as compared with the market wage rate. Apparently in most of the under-developed countries the opportunity cost of labour is less than the prevailing market wage. But if all the indirect costs including the effects of redistribution of incomes are taken into account, it is possible that the shadow wage will exceed the market wage.

II. COST BENEFIT ANALYSIS IN PRACTICE

It is not surprising that the cost benefit method as practised in under-developed countries where statistical information is not available to the extent and in the form required, and where the efficiency of the administrative mechanism is not of a high order, is only of a primitive type. The importance of the method is recognised, but only some simple and rather crude methods are employed for the selection of projects in some sectors of the economy.

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[1] Sen, A.K. "Control areas and accounting prices: an approach to economic evaluation," *Economic Journal*, London, Vol. 82, 1972 pp. 486-501.

In the Indian states, in respect of those areas of development which are the State's direct concern, the guidelines given by the Union Government have been followed with little or no modification. Originally as recommended by the Union Government much importance was attached to the rate of return on investment in the case of irrigation projects. However, in 1958, the Union Planning Commission felt that the rate of return criterion was inadequate and unsatisfactory and stressed the need for assessing the overall benefits of a project. Studies were initiated for this purpose and completed under the direction of Prof. D.R. Gadgil in 1961. As regards irrigation projects, large benefits accrue in the form of double cropping, improved quality of crops, higher yields, larger incomes, greater employment opportunities besides a large number of indirect benefits such as establishment of processing industries, development of retail trade and expansion of transport and communications. In other words, the total direct and indirect benefits from irrigation are far greater than indicated by the financial returns. Hence, the Commission recommended that benefit cost ratio studies should aim at assessing the economic feasibility of new projects rather than assessing the direct financial returns to Government. Since 1964, this principle has been observed atleast in the case of irrigation projects. The steps involved in arriving at benefit cost ratios are, a comparison of the value of total net agricultural production before and after irrigation; and then working out the net returns by deducting the annual costs which include interest on capital, depreciation and administrative expenses.

However, in the case of electricity projects which are under the charge of the State Electricity Boards, the earlier crude method of calculation, namely, the rate of returns on investment, is still continued. Thus in Tamil Nadu in the project report on Tuticorin Thermal Power Station prepared in 1972, the cost per unit of electricity generated and the rate of returns on the existing tariff charges were estimated. The financial analysis reads, "the cost per installed kW namely Rs.1831 for the project is very reasonable, considering the general increase in the prices of plant and equipment. The cost per unit works out to 7.9 paise which is cheaper than the cost of nuclear power. It is cheaper than what it would cost if alternative thermal power from any other source is to be transmitted to the load centre near the Tuticorin area. The project is expected to yield a return of 12.54 per cent in the year 1980-81, i.e., within a year of the commissioning of the second unit."[1] The ratio is worked out in the same manner as in the case of hydro-electric projects.

The obvious reason for relying on the rate of financial returns as the criterion for judging the feasibility of an electricity project is that it is difficult to estimate even the direct returns on the investment, not to speak of indirect returns. But the point to note here is that an attractive rate of financial returns is not the same thing as a favourable benefit cost ratio.

III. NEED FOR A MODIFIED METHOD IN AN UNDER-DEVELOPED COUNTRY

Clearly, it is necessary on the part of the State before making any financial commitment to make sure that the investment does not result in any great financial loss, but on the other hand, brings in a fair rate of return. But it is equally important that the State does not look at an investment entirely from the point of view of an entrepreneur primarily interested in making profits. The State is responsible for the welfare of the present as well as future generations and it should take into account not only the direct benefits and costs of a project but also the various indirect benefits and costs affecting the entire community; or it may be interested in social welfare measures, the

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1. Tamil Nadu Electricity Board: Project Report on Tuticorin Thermal Power Station, Madras, October 1972, p. 54.

value of which cannot be assessed in terms of money. All these point to the need for a continuous refinement of the method used now. Progress in the line can be made only in stages and is bound to be slow. In general, it may be suggested that a beginning may be made by:

(a) Adopting the discounting method to enable comparison being made of present values and costs.

(b) In the case of electricity undertakings, it may be possible to make atleast a rough estimate of direct returns.

(c) Extension of the use of Benefit Cost ratio to other sectors.

(d) Where quantification of costs and benefits is not possible, investigate the scope for using qualitative assessment.

(a) Discounted Present Values for Irrigation Project: As stated earlier, in respect of irrigation projects, the annual current costs of a project are compared with the annual current returns. Under costs are included interest charges, depreciation, administration, etc., and under returns, the value of additional crops produced. Thus if it is estimated that after completion of the projects, the returns per year will exceed the costs, then the project is recommended. The assumption here is that what is true of the next year will be true of the future years also, but this assumption in most cases may turn out to be incorrect. The State has to look far into the future and the planner has to envisage the future potentialities of a project as well as the need or scope for its expansion and modification. For illustration, an irrigation project may continue to serve its purpose over a period of fifty years or more. In the course of this period, there may be a need for altering it or making improvements on it in the light of technological changes and emerging economic conditions. The annual costs and returns in the tenth year may be different from that in the twentieth year. Hence, when planning is done for a long period, both the returns and costs in the future have to be worked out in detail. But since capital outlay is to be incurred immediately, it is necessary to compare the present value of all future returns and future costs. Discounting, therefore, becomes necessary.

(b) Returns from Electricity Undertakings: While in the case of irrigation projects direct economic returns are taken into account, in the case of electricity projects only the financial benefit from the point of view of the government is considered. The revenue yield depends on the tariff rate. Suppose the rate is 10 paise per unit and 10 million units are generated and sold. Then tariff collection is Rs.10 lakhs; and if annual cost is Rs.4 lakhs, the net annual returns will be Rs.6 lakhs. Assuming investment to be Rs.50 lakhs, the yield works out to 12 per cent of investment. This rate may appear to be fair compared with the prevailing rate of interest and so the project may be approved. But it is clear that the rate of returns depends directly on the tariff charge and does not in any way reflect the economic returns of the project or its real value.

There are of course obvious difficulties in estimating the returns from an electricity project. Nevertheless, an effort may be made to calculate the money value of the economic returns from the project. The contribution to income growth is a fairly reliable indicator of these economic returns. Electricity generated is used up by industries, agriculture, transport and in domestic consumption. The proportion of the total supply taken up by each of these sectors is known. Hence, when as a result of constructing a new project, a certain quantity of electricity is added to the grid, it may be assumed that the additional power will be distributed in the same proportion as the existing supply. If the income generated in these sectors is also known, the relation between electricity consumption and income generated may also be found, and hence it would be possible to establish a rough relationship between rate of increase in returns (growth of income) and rate of increase in costs.

(c) Extension to Other Sectors: The next step is to extend the simple benefit cost method to other sectors of the economy, particularly to those sectors which spend heavily on construction works, as for example, transport or industries. Thus, for road construction, the initial cost and the annual recurring cost can be easily estimated. As regards returns, the value of the service which a road renders in the form of easier transportation, quicker movement of goods and persons or expansion of trading facilities can be worked out. In the case of an industrial unit, particularly when it happens to be small, located in a village and started and controlled by the government, returns in the form of additional employment, and additional value of output, both of which are direct benefits, can be calculated without much difficulty.

(d) Qualitative Assessment—an aid to the fixing of the priorities: In respect of some sectors, which defy methods of quantitative assessment of returns, it would still be possible to make a qualitative assessment of their contribution. For instance with regard to public health, the initial cost of starting a specific programme, say, constructing a T.B. sanatorium and the recurring costs are known. As regards returns, this may arise in three ways—first, individuals benefit in the form of improved health and increased earning power, second, society benefits in the form of improved health standards, and third, there is a gain to the public health department itself in the form of saving in costs because of decrease in the number of cases to be attended to and treated. The incidence of a disease in a particular area causes an economic loss because of loss of mandays in agriculture, industries and services and the loss of earnings from the point of view of the individuals concerned. In both cases the money value of the loss can be computed. The reduction or avoidance of this loss is an economic gain to society.

Similarly, as regards education, benefit cost ratio may be worked out by comparing the cost incurred by the person concerned and the State on education with the benefits that will accrue to the individual as well as to the society, as a result of improvement of educational standards. From the point of view of the individual, costs of education are made up of the fees which he pays and other expenses which he has to meet in his school or college course and the earnings which he would have foregone in attending the school instead of engaging himself in some remunerative employment. On the other hand, the returns will be the extra earnings which he gets by virtue of his educational training. The costs incurred by the State on the education of an individual at different stages can be worked out, but it is in the matter of estimating the social benefits resulting from education that difficulty arises.

What is stated above regarding the difficulty of making an assessment of the benefits and costs of public health and education applies to all projects falling within the area of social welfare. This raises the fundamental question whether quantification is at all necessary. In this connection it is worth bearing in mind three important points. First, even when the assessment is in quantitative terms, it is not altogether free from any qualitative judgement. Thus in the case of many items of costs and benefits which cannot be expressed in money terms, indirect methods are employed to evaluate them or we impute values according to our judgement regarding the benefits or costs. Here obviously a subjective element enters. Second, even when the evaluation of a project is done with meticulous care and on highly sophisticated lines and the project is recommended on the basis of these findings, there is no guarantee that the project will be implemented. The government may run it down on other considerations as in the case of the Roskill report on the proposal for a Third London airport.* The point to note here is that acceptance of a project by the decision maker depends on many other factors than economic or social. Third, imputing money values to the costs and benefits side, gives an appearance of accuracy, but this is nothing more than an appearance. Ultimately, it is the ranking of the projects that matters.

If then ranking or listing of the projects in some order of priority is the main consideration, it is possible to rank the projects on the basis of qualitative judgement as well. Consider for illustration such socio-economic objectives as improving welfare or bringing about more equitable distribution of wealth and income. A number of factors affect welfare as well as the pattern of distribution. What is important here is to assess the relative significance of these various factors and though it is not possible to express these values in money terms, yet it is possible to give each of these factors a certain weightage which would help in estimating their relative significance and assigning them a rank in the list of priorities.

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*Littlechild, S.C.—The use of Cost Benefit Analysis—a reappraisal. "Contemporary Economic Analysis" edited by M.J. Artis and A.R. Nobay, London, 1978, pp. 354-390.

If the objectives are defined and the purpose is to assign priorities to different projects, then it is possible to arrange them in an order of priority by assigning hypothetical values. This can be illustrated by a simple arithmetical example.

Let the objectives of the plan be expressed as Y—increase in the national product; E—increase in employment; S—increase in savings; H—increase in some health index such as an increase in the expectation of life or a decrease in the infant mortality rate.

A project—Project I—will yield increase in the above four items and this is indicated by Y_1, E_1, S_1 and H_1. Similarly, Project II will yield Y_2, E_2, S_2 and H_2. A value has to be attributed to these increases. Let these be p, q, r and v. Then the valuation of Project I will be $V_1 = Y_{1p} + E_{1q} + S_{1r} + H_{1v}$ and that of Project II will be $V_2 = Y_{2p} + E_{2q} + S_{2r} + H_{2v}$. We assume that the components on the cost side are two—namely, capital invested, $k_1, k_2 \dots k_n$, and foreign exchange required, $f_1, f_2 \dots f_n$.

Let the desired increase in the plan objectives be as follows:

Y : Increase in the national product, Rs.1,000 crores.
E : Increase in employment, 1 crore persons.
S : Increase in savings, Rs.400 crores.
H : Increase in life expectancy, 1 year.

The relative contribution of the two projects may be assumed to be,

PROJECT I	*PROJECT II*
Y_1 Rs.1 crore	Y_2 Rs.80 lakhs
E_1 500 persons	E_2 1,000 persons
S_1 Rs.50 lakhs	S_2 Rs.10 lakhs
H_1 0 year	H_2 1 year

In order to calculate the total value contribution of the two projects, we have to fix relative values for the objectives. Let us suppose that an increase in income of Rs.1 crore = additional employment of 500 persons = increase in savings of Rs.0.2 crore = an increase in life expectancy of 2 years. Then the valuation of Project I will be $1 + 1 + 2.5 + 0 = 4.5$ and that of Project II, $0.8 + 2 + 0.5 + 0.5 = 3.8$. If the costs involved are k_1, Rs.2 crores and f_1, Rs.50 lakhs and k_2, Rs.1.2 crores and f_2, Rs.20 lakhs and each crore of rupees in cost is fixed as equivalent to 1, then the relative cost of the two projects will be, Project I, 2.5 and Project II, 1.4. Then cost benefit ratio will be, Project I = $4.5 \div 2.5$ (1.8 : 1) and Project II = $3.8 \div 1.4$ (2.7 : 1).*

If should be remembered that the values are fixed in an arbitrary manner depending on the planner's judgement. Also, only relative values are indicated in respect of the projects. Thus, if the objectives of planning change, i.e., if greater importance is attached to employment generation than to income creation, then the cost-benefit ratio of the two projects would change to the extent that the effect of the one on employment creation would differ from that of the other.

An estimate like this will only help in ranking the projects according to their relative values. The number of projects to be selected, and whether a particular project will be chosen or not, will depend on the resources available for investment and the rank of the project in the list.

It is not suggested that the method of ranking outlined above should replace cost benefit analysis. What is stressed here is that if the objective of cost benefit analysis is to assign the order of priorities to competing projects so as to help the planner or administrator to make his choice, then it is far better to furnish him with full information regarding the various points to be considered and their relative importance than to present a simple looking ratio, based on elaborate and complicated calculations but the returns of which in terms of accuracy and reliability are far less than the costs and effort involved in its computation.

*U.N., *Programming Techniques for Economic Development*, Bangkok, 1960, pp. 35-39.

CHAPTER 9

Monitoring and Evaluation

The importance of monitoring and evaluating a plan project is recognised by the planning agencies both at the Central and state level. When a plan project is launched it is assumed that normally it will be completed after a certain period of time, involve the spending of a certain amount of money as well as the use of manpower and materials. However, in the process of execution of the plan many unexpected things may happen which require the modification of the plan or postponing the date of completion or using more manpower and materials than was originally indicated. Hence the need for watching, scrutinising and checking up the progress from month to month, quarter to quarter and from year to year.

But the machinery and the method employed at present for the purpose in most of the low income countries appear rather crude and of a routine nature. One method which is commonly adopted is to send a questionnaire or proforma at regular intervals of time to the Heads of Departments entrusted with the responsibility of executing the projects with a view to elicit information about the physical and financial targets achieved, the difficulties and constraints as well as their suggestions to meet the difficulties. A glance at the periodical reports gives one the impression that the Heads of Departments show some interest in this work chiefly because they hope to get some additional financial provision for their projects if a favourable impression is created on the planning authorities. It is not usually an objective and critical assessment of the progress.

The inadequacy of the present method springs mainly from the fact that the questionnaire is of a routine type common for all projects. In order to elicit information on special points relating to a particular sector the questionnaire has to be specially designed for each sector. Further, the questionnaire is of a general nature. Thus, the information that is called for is about financial and physical targets fixed for a quarter, actual achievements, the extent of shortfall, reasons for the shortfall, employment generated and the like. The routine method of enquiry calls for only routine answers which do not provide the material necessary for making any critical appraisal.

Need for a Sophisticated Method

The right approach to monitoring and evaluation is the PERT and CPM—(Programme Evaluation and Review Technique) and (Critical Path Method). The two are closely allied. A brief account of these methods given in the following pages brings out their usefulness in formulating a project and in monitoring and evaluating it.

The PERT and CPM represent a scientific system or method of setting forth the major components or items of work of a project or plan arranged in logical sequence. It describes each item of work, the time taken at the cost involved in completing an item of work, links up the items of work with the preceding and succeeding activity, and shows clearly how all these interrelated items of work lead towards the fulfilment of the objectives of the project by utilising the resources--time, manpower, materials and financial resources in an optimal manner. Thus PERT helps in (1) planning a project, (2) executing or implementing a projeot, (3) monitoring or checking up the progress of the project, and (4) replanning or modifying a project.

Preparation of a work breakdown schedule is the first step in organising the PERT. The major objectives and the major works of a Project are to be defined and then the supporting objectives are to be linked up to the major objectives so that the planner can see the relationship between and among all the objectives. Thus in the case of constructing a building the major objective or level I is construction and the supporting objectives

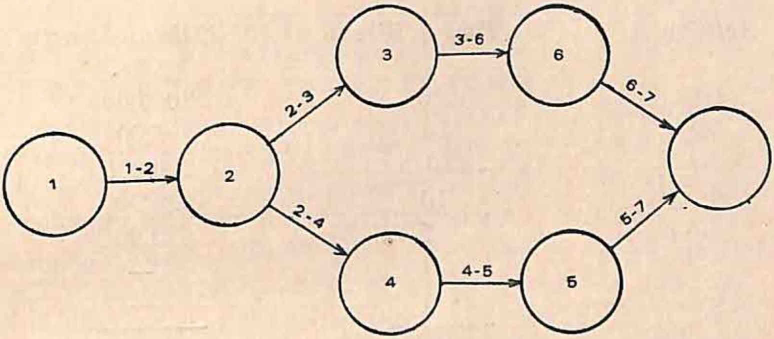
—level II—are site preparation, masonry, carpentry, and finishing. Each of these supporting objectives can be further split into sub-items and these again in turn can be further subdivided. Work break-down schedule gives complete details of all items of work involved in a Project in a systematic way bringing out clearly the interrelationships among all phases of the project.

Activities and events form the basic elements of a PERT programme. An activity begins and ends in an event. Once the activities are enumerated or listed, it is necessary to define clearly the relationship of a particular activity to the activities which precede and which succeed it and also those activities which can take place concurrently. The network is a graphic arrangement of all the activities and events of a project by means of two basic symbols—a circle in which the number of a uniquely defined event is indicated and an arrow representing an activity. The arrow starts from a preceding event and points towards the succeeding event. An activity cannot be started until the event preceding it has occurred and it may represent a process or a task, procurement of a material, working time, or simply represent a connection or interdependency between two events on the network.

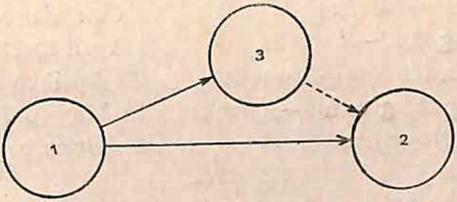
Consider for example, the work connected with an irrigation project. This involves the following phases of work:

1. Approval of the Project.
2. Land acquisition.
3. Fixing the contracts.
4. Digging of canals.
5. Lining of canals.
6. Construction of sluices, etc.
7. Completion of the work: settlement of accounts.

These seven items of work are expressed as activities. It should be noted that there should be no more than one activity having the same preceding and succeeding events. This means that each activity is represented by a uniquely numbered arrow. Further when once an activity starts from an event it should proceed forward and should not come back to an event that has already happened. In other words, there should not be any loops in the network system. The relationship between activities and events is depicted in the PERT network given below:



The activities shown by arrows proceed from one event to another event. However, in order to give a unique number to each event and to depict clearly the sequence of events, it may some times be necessary to introduce dummy activities. A dummy activity is defined as an imaginary activity which can be accomplished in zero time and which does not consume resources. It is represented by a dashed arrow:[1]



The diagram shows that activity 1-3 should be finished before event 3 and activity 1-2 should be finished before event 2. There is no activity like 3—2, but 3 has to be reached before 2 can start. In order to indicate the precedence of 3, 3 and 2 are connected by the dashed line or arrow which points towards 2 from 3. The dashed line represents an activity which involves no time and no resources.

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[1] Prasanna Chandra, "Projects—Preparation appraisal, implementation", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1980, pp. 224-245.

Time required for each activity and the cost of each activity can be indicated in a schedule.

Activity	*Time in Weeks*	*Estimated costs* Rs.
1-2	10	100,000
2-3	4	5,000
3-4	20	100,000
4-5	10	50,000
5-6	5	20,000
5-7	1	—
6-7	1	—
	51	275,000

The net work time expressed in weeks can be converted into calendar time. In fact, this is necessary for monitoring the work and to check up whether the required progress is maintained at each stage. For illustration, the work in connection with construction of a road may be broken up into the usual net work time as well as the calendar time. The work is to be completed in 17 weeks and starts on 1st April.

Net work time	*Calendar time*
Acquiring land—4 weeks	1 April to 28 April
Calling in tenders—2 weeks	29 April to 12 May
Levelling the ground—3 weeks	13 May to 2 June
Bringing together materials— 1 week	3rd June to 9 June
Laying the road—4 weeks	10 June to 7 July
Gravelling—1 week	8 July to 14 July
Finishing with bitumen— 2 weeks	15 July to 28 July
17 weeks	17 weeks

The technique of net work analysis has some obvious advantages. It necessitates logical thinking on the plan and the project from the beginning to the end. The project duration is determined clearly and defined accurately. It provides a detailed picture of the various activities in the project, particularly the activity or activities which are critical to the completion of the project and helps in discovering a method of shortening the schedules and identifying schedule slippages when they occur. Lastly, it provides the management with a tool for more definite reporting and effective control of the Project.

Before any programme of work gets started, it is necessary to have an over all bird's-eye view of the entire project—a view which cannot easily be obtained by other planning and scheduling methods. Planning the project with the net work technique provides an assurance of the validity of the Project schedule and a basis for evaluating related questions of project feasibility. Another important value of net work is that it helps evaluating agencies such as governments, the World Bank and other Financing agencies such as the Life Insurance Corporation of India, the Unit Trust of India etc., by providing them a visual evidence of the depth of physical work planning accomplished as well as a clear view of the items of work to be done and their costs. Reference to the net work plan enables rapid identification of the major elements of the Project as well as the interdependencies and relationship among them. All these help the financing agencies to take a decision with regard to the worthwhileness of granting the assistance or aid.

Time Analysis

One important feature of the PERT technique is the great emphasis which it lays on the optimal utilisation of time. To ensure this the time factor is analysed in detail and its different aspects defined clearly.

At the outset it is necessary to make an estimate of the time that will be taken up by the different phases of the project as well as the project as a whole. In PERT analysis time is classified as:

(1) Optimistic time—the shortest time within which it is optimistically hoped that a particular phase of the Project will be completed—indicated as (to)

(2) Most likely time, i.e., how much time the activity of a project would not probably take—indicated by (tm).

(3) Passimistic time—the length of time which an item of work would take at worst indicated by (tp).

(4) Average time—the expected value of activity duration time (te). Average time is derived by applying the formula

$$te = \frac{to + 4\ tm + tp}{6}$$

The assumption here is that to and tp are equally likely and tm is four times more likely than to or tp. This can be illustrated with reference to the construction of a mile long road.

to	2 months
tm	3 months
tp	6 months

$$\text{Hence } te = \frac{2+(4\times3)+6}{6} = \frac{20}{6} \text{ or } 3\tfrac{1}{3} \text{ months.}$$

Element of Flexibility in PERT

The demarcation of the different stages of work in a project, and assignment of a time for the starting and completion of each stage and the linking up of the event with a preceding and succeeding event, all these would indicate a framework with an element of rigidity built into it. Yet, with all this a plan or a project quite often goes awry, the targets cannot be fulfilled in time because of lack of materials or manpower or because of financial constraints. Obviously, the manager or the planner should be prepared to meet such eventualities and should work out methods of circumventing or overcoming these obstacles or delays.

It is possible to make such readjustments in the PERT because of the fact that though the time is predetermined for the completion of the different phases, yet in some cases the allotted time may be longer than what is actually required to finish the job. Or it may be possible to reduce the time by more intensive effort to finish it quickly by applying more resources or working over time.

EOT denotes the earliest occurrence time of an event; in other words, it represents the minimum time required for completing the project. In order to calculate the EOT of a particular event we start from the beginning and move forward towards the end through successive events. Here we assume that there is no gap between the ending of an event and the commencement of the succeeding event, i.e., we assume that each activity starts immediately on the occurrence of the event preceding it. Thus the earliest starting time (EST) and the earliest finishing time (EFT) can be determined. The LOT (or latest occurrence time) of an event represents the latest available time by which the event can occur given the time that is allowed for the completion of the project. The slack for an event is the difference between its latest occurrence time and its earliest occurence time. Suppose in a PERT chart the activity between two events 2-3 may be completed in ten weeks while another activity 2-4 can be completed in twelve weeks. Next activity 4-5 can start only after event 4. So there is a leeway or excess time allowable in the case of activity 2-3. In other words, it does not matter whether 2-3 is completed in ten weeks or takes up a little more time provided it is completed in twelve weeks time for the next activity cannot start before 2-4 is completed and the time allowed for this is twelve weeks. This two weeks extra time allowable in the case of 2-3 is the slack for that activity. "Thus the latest allowable completion time helps in determining the extent up to which an activity may be delayed without causing any upset in the completion time of the Project."[1]

Time/Cost Relationship

A project involves time asw ell as money cost. A certain number of labourers are made to work for a certain number of days to complete a project. If time is to be reduced, more labourers will have to be engaged or the existing number of labourers are to be made to work over time; or possibly more costly capital equipment is to be used. As time is reduced, cost of labour rises. On the other hand, if time is not a scarce factor, it would be possible to engage less number of labourers, but the work may be spread over a longer time. Here cost of labour per day is less but total cost may be high because of longer duration of the work on the project. The problem of the manager is to get the best time cost relationship.

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[1] Mattoo, P.K., "Project Formulation in Developing Countries", The Macmillan Co. of India Ltd., 1978, pp. 102-104.

Two major constraints which generally stand in the way of fulfilling the targets in time are two: (a) manpower constraint, (b) financial resources constraint.

In the case of manpower and financial constraint it becomes necessary to revise the original work schedule. This can be illustrated.

(i) Suppose a work is to be completed in 5 days. Manpower requirements are:

First day	20 men
Second day	14 men
Third day	15 men
Fourth day	5 men
Fifth day	5 men

The number of men available is only 12 and this means that the work as scheduled above cannot be done in the first three days. For, the labour required per day in the first three days is more than what is available. If the project duration is rigidly fixed at 5 days no scheduling is possible with only 12 men. Given this constraint the only alternative is to extend the duration by one day and reschedule the programme of work in such a way that maximum employment in any one day is 12 men.

(ii) Now suppose the allotment of funds by the government for a project is Rs.1,50,00,000 distributed over three half year periods as follows:—

First 6 months	Rs.69,00,000
Second 6 months	Rs.68,00,000
Third 6 months	Rs.13,00,000

Suppose the requirement for each half year period is Rs.50 lakhs. Then, if the total allotment of Rs.1½ crores is spread over the three half year periods in the above manner, it would not be sufficient to meet the financial requirements of the project as ori inally scheduled, for example, in the first two half year periods the allotment is higher than what can be efficiently utilised and in the third period it is lower than what is required. It is possible that if the allotment for the first two half year periods is reduced and that for the last 6 months period is raised, the project can be completed in the time fixed in a more satisfactory manner. This necessitates the rescheduling of the project.

Resource Levelling and Crashing

These two terms relate to the process of rescheduling or modifying the project with a view to get over the resources (financial and manpower) constraint and the time constraint. When the resources are limited, but the demand for resources is higher than originally envisaged, than it is necessary to cut short outlays at certain points or extend the duration of the project. And if the latter (extension of time) is not possible, then resort is to be had to resource levelling to the altered circumstances. On the other hand, time may be a limiting factor. The project has to be completed before a fixed date. Since progress up till now has been a little slow, the remaining period of time is found to be hardly sufficient to carry through the remaining activities.[1] In a situation like this, the activities of the project can be expedited by 'crashing' which involves employing more resources. Crashing reduces time, but only at the cost of increased financial outlays on account of over time or extra payments and wastage. Thus there is a trade off between costs and time which is illustrated by a downward sloping straight line as shown at page 128.

Rs.200 and 80 days represent the normal cost and time. Point A represents the point of crashing at which the cost rises to Rs.600 but the time is reduced to 30 days. The line AB indicates that every gain in time involves a higher and higher cost and the slope of the line measures the rate at which time is exchanged for cost and *vice versa*.

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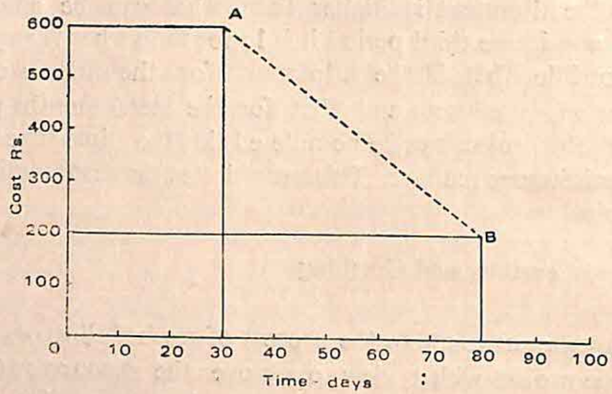
[1] This situation may arise because the time used up for finishing the preceding activities has exceeded the allotted time. This is a case of time overun.



When the need is to squeeze the time required for an activity or activities the project planner has to rely on the net work to find out the best means of achieving this end. The net work provides a time schedule and indicates the duration of the project and as such it can be used as a basis for verifying not only the total project estimate of cost but also the phasing of capital expenditure on the project. This can best be done by using the Critical Path Method. The critical path starts with the beginning event and ends with the final event. It is the longest path to the end event and contains no slacks. Since the project reaches the termination point only when the critical path is gone through, the minimum time for executing the project is determined by the length of the critical path. If the management or the planner finds that the length of time required by the project as indicated by the length of the critical path is greater than the one desired, then it would become necessary to analyse the critical path and examine if its length, can be reduced. There are several means of achieving this objective such as improvement in the methods, introducing greater parallelling of activities, transfer of resources from non-critical paths to the critical path, assignment of over time or additional resources on the critical path activities, etc. Once the critical path has been compressed, rescheduling can be done without difficulty.

PERT as a Tool for Monitoring and Evaluation

PERT helps not only in formulating and executing a plan or a project but also in monitoring and evaluating the project at each stage. The fact that the project is split up into various activities and the time and cost for finishing each activity are determined in advance, enables the controlling authorities in charge of the project to maintain a close watch over the progress of the project and to check up whether the events take place according to the time schedule. It would be possible to have a clear idea of the shortfalls and the causes of such shortfalls, be it shortage of manpower, machinery or materials or other inputs or extraneous factors affecting the work.

If government is the controlling authority, the execution of the project is entrusted to departmental heads who may delegate some functions to contractors. But since the responsibility of carrying the work through devolves mainly on the officers, they are answerable to the government in case of slow progress, high costs, or failure to attain the targets fixed in respect of each activity and event. Thus a PERT network helps both parties—the government which is the ultimate controlling authority and the engineers and other officers who are in immediate charge of the different phases of the project in checking up the progress of work.

Coordination between the execution of the works and the financing of the works is achieved by means of performance budgeting. The performance budget is a plan of action in financial and physical terms phased over a time profile. It becomes a concrete plan of action insofar as it breaks up the financial and cost implications of a multi-year programme into annual budgets. It determines the responsibilities of executive heads in terms of objectives to be attained and thereby facilitates more effective and efficient monitoring of the project.

Performance budgeting is essentially a technique by which programmes, sub-programmes, projects, activities, tasks, etc., could be identified in a budget in financial and physical terms so that it would be possible to establish clearly the relationship between the inputs on the one hand and the outputs on the other. In combination with the network technique it facilitates decision-making on problems thrown up during the implementation of the projects. Apart from this, the normal annual budget itself becomes a more realistic document when it is based on a knowledge of the physical work to be carried out expressed in terms of schedules and activities and a detailed analysis of cost of operations.

Adoption of PERT as a Means to Monitor and Evaluate Plan Projects by the Planning Bodies

PERT is a sophisticated and advanced technique of formulating, monitoring and evaluating a development project. It presumes the existence of a competent and expert body to initiate and organise the work and operate it successfully. Nevertheless, it is worthwhile on the part of even developing economies to try and make use of this technique at least in some areas or sectors of the economy. To begin with, it should be possible to select some projects distributed over all the sectors of the economy for which PERT charts can be prepared. This has to be done in consultation with and with the assistance of Heads of Departments as well as experts familiar with the methods of network analysis. The number of projects selected for the purpose may be delimited with reference to the outlay envisaged (for example, include only those costing more than a crore of rupees or so) or by restricting to schemes which are easily amenable to this sort of analysis and evaluation or by taking up projects which are important from the point of view of the attainment of the major plan objectives.

For each of the selected projects a PERT chart has to be prepared in consultation with the department concerned and based on full particulars relating to the project—the cost, materials required, manpower required, phasing of the programme, length of the time which each activity would take, etc. One copy of the chart is to be kept by the planning agency and one by the respective department.

At the end of each quarter the planning body would send a proforma or questionnaire to the various departments. This questionnaire should be based on the details presented in the PERT chart. That is, the points to be clarified and the details to be filled in are all to be with reference to the activities for the quarter indicated in the chart.

The departments would send their quarterly report in the form of answers to the questionnaire prepared and circulated by the planning agency in the first month after the end of the quarter to which the review relates. The date for the receipt of the answers may be fixed in advance. The report from the departments would show the progress made, materials consumed, manpower employed, and the cost incurred; and also give reasons for lack of progress or slow progress, if any, failure to achieve the target, whether any deviation has been made in the projects, inadequacy or delay in the supply of materials or funds, difficulties in land acquisition or delay caused by unforeseen events. The important point to note here is that the proforma is based on the PERT and the answers will be directly related to the stages, patterns and cost indicated in the PERT.

After the answers to the questionnaire and the reports of progress are received from the Departments, the planning body may have a meeting with the departmental officers for discussing and clarifying any doubtful points given in the proforma. Review of the progress of works is necessary to evaluate whether the project works are progressing as per the PERT network or not. This review may lead to the revision of the networks or acceleration of some of the activities which would create new critical paths, or necessitate investing extra resources in order to keep up the original target date. The process of reviewing the works 'progress' (based on PERT network) is technically known as 'updating'. It is a combination of monitoring and control processes. Here past progress of the work is reviewed and future estimates of cost and time required for completing the works are made.

The following steps are involved in updating the PERT periodically:

(1) Incorporate the progress data in the network.
(2) Mark the updating period in the net work.
(3) The updated network may contain the original network indicating both the completed works and the works to be taken up in future; or if the network is a complicated

one, the completed activities can be deleted and only that portion of the network representing the activities yet to be performed is presented.

(4) Reviewing, monitoring and updating will continue till the completion of the project.

At the end, a detailed report for each project can be prepared—showing the time taken for completion—difference between the targets and actuals in respect of time, cost, materials and manpower, deviations from the original scheme. justification for such deviations, measures adopted to economise the use of resources or to expedite the work, additional employment opportunities created, causes for delay at different stages—delay in getting approval and sanction, delay in getting supplies of inputs and funds, in land acquisition, in fixing contracts, procedural complications, etc. All this information will enable the planner to prepare similar projects in future on a firmer basis.

CHAPTER 10

Planning from Below : District Planning

Why Plan from Below

Planning implies a careful husbanding of the resources and their utilisation in the best manner. But if planning is to be democratic it is necessary that the development plan is broad based in the sense that in drawing it up the people for whom it is meant have co-operated and that in executing it and in implementing its proposals, an equal measure of people's willing co-operation is forthcoming. These two aspects of planning —husbanding of resources and its being broadbased—underline the need for making use of regional or local sub-plans for building up a state's or country's plan.

Consider a vast country like India with an extent of 1,176,864 sq. miles and a population of 658.14 millions (1981)* spread over 22 states and nine union territories. Different regions in the country are endowed differently. If planning for the whole country is to be meaningful, these differences are to be taken into account. The pattern of utilisation of resources differs from area to area and there is need for special programmes of development suited to each region. Here the aim should be to develop the resources of each area to the greatest extent and in an optimal way. The overall plan should aim not at levelling down but at levelling up; disparity between the different regions should be reduced without affecting growth.

In India the states and the areas which are directly administered by the Central government are divided into more than

*According to the 1981 Census.

350 districts. These are administrative units, and they may have specific development problems to tackle. For this reason, a state's plan or a National plan based on an assessment of the resources and potentialities of the different regions would be more realistic and meaningful than one which takes into account only the general problems and requirements of the country as a whole.

Further, in planning at a lower spatial level, decision-making becomes relatively easy. Full participation of the people in the preparation and execution of the plan is possible only if it is done on a lower level geographically. Here the important point is consultation with local people who would be able to express their needs and aspirations and also be in a position to make intelligent proposals about the utilisation of the resources. As Prof. Heal observes, "the planning problem is too large to be solved by the Centre; much of the detailed information about production possibilities, information of which a plan must take cognizance is not of a type which can easily be formulated and communicated. Hence it follows that at least some part must be played in plan construction by "the man on the spot in order to take advantage of the information and skills possessed by him."[1]

Planning from Below—Two Approaches

What is generally called planning at the grass-roots level or planning from below is in contrast to what has been the practice in Indian planning so far. Since 1950-51 when planning started in the country the Union Planning Commission at New Delhi has been drawing up five-year plans and annual plans for the entire country. These plans lay down broad patterns of development, formulate sectoral programmes, indicate the financial and investment requirements and fix the physical targets for achievement. The states do prepare their own plans but their area is restricted to subjects which are their direct concern and exclude subjects of national importance. Moreover, the states' plans are to conform to the framework provided in the all India plan. The financial and physical resources available to them constitute another important constraint. This approach to planning creates the impression that at the state level, the scope for independent action and decision-making is unduly restricted.

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[1] Heal, G.M., "Theory of Economic Planning", North Holland Publishing Company, Amsterdam, London, pp. 70-71.

On the basis of the choice of a geographical area as the unit of planning, it is possible to identify two different approaches. One concentrates on local needs and local potentialities and aims at the specific objective of achieving higher levels of employment and eradication of poverty. Block level planning is made much of because it is the only means of concentrating on sufficiently small areas and specific problems. Planning in this sense cannot have in view the broad picture of the economic development of the country as a whole or even of a state as a whole but biased in favour of much smaller geographical units with their own individual and distinctive problems. They may be an effective means of achieving the specific purposes in view, but the sum of such block level plans is not and cannot be the state or national plan.

On the other hand, regional or district plans may be visualised as a technique of building up the state or the national plan on the basis of plans for local areas. Here the emphasis is on administrative feasibility, and the objective is to avoid losing sight of the potentialities and needs of local regions or areas by focusing too much on the development pattern for the state or country as a whole. Viewed in this manner, a programme of development is to be drawn up for each district every year and for each five year period in such a manner that the district plans can be merged into or integrated with the state's annual or five year plans. And the latter in turn can be made use of as part of the national plan.

The Block Level Plan Envisaged by the Planning Commission

Of the two approaches to local planning mentioned above—block level plan with a specific objective, and the district plan as the basis for the state plan—the Union Planning Commission is at present concentrating on the first. According to the guidelines finalised for the purpose,[1] grass-roots planning would mean planning from the level of the community development blocks, numbering 5,000. To organise, supervise and monitor block level planning, special cells are to be set up in the state planning boards which should function as a clearing-house of information and an agency for supervision and guidance.

At present, 2,000 blocks have been identified in the country for integrated rural development. It is indicated that the state governments should draw up plans in as many blocks as is feasible during the current plan period. Over and above this, 30 blocks are to be selected every year additionally for area planning and implementing proposals for achieving the objective of full employment. The Planning Commission has also suggested that the block plan may be prepared with a seven year perspective from 1981-82 to 1987-88 synchronising with the remaining years of the states' Sixth Five-Year Plan and the full five-year-period of the states' Seventh Plan.

It is clearly stated that one of the most important objectives of block level planning is the reduction and eventual elimination of unemployment and underemployment in order to increase the income of the people living below the poverty line. The realisation of this objective implies the augmenting of the incomes of small and marginal farmers, village craftsmen, scheduled castes and tribes and also involves carrying through of specific programmes of technological improvement and reorientation of credit and marketing institutions.

The guidelines stress the point that the block plan should not be prepared in isolation but must be closely coordinated with the state plan. Nevertheless, block plans are to be differentiated from district, state or Central Planning. The point of differentiation is that the content of the block plans should cover programmes aimed at optimising the production potential of the area in agriculture, animal husbandry, forests, village and small-scale industries, special production programmes in the light of the resource potential, manpower planning and skill development and programmes for the provision of basic minimum needs, etc.

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[1] *Guidelines for intensive development of blocks under the programme for integrated rural development*, Vol. I, Department of Rural Development, Ministry of Agriculture and Irrigation, Government of India, Krishi Bhavan, New Delhi, May, 1978.

From what has been indicated above, it is clear that the block level plan will be substantially a plan for production-cum-employment purposes. The basis for planning at the block level will be first, a detailed socio-economic survey, second preparation of resource inventories on a scientific basis, and third, manpower budgeting. It also presumes consultation with officials as well as with non-officials before the draft proposals are finalised.

A prerequisite for the assessment of the development potential of blocks is the collection of basic statistical data. It is possible to divide the state or the districts into geographic or economic regions with more or less similar endowment of natural resources. For this reason it is likely that one or more blocks will fall into the same region. The statistical information that is required will comprise:

(a) Economic infrastructure made up of
   (1) Communication system,
   (2) Marketing facilities,
   (3) Storage and werehousing facilities,
   (4) Irrigation and power distribution network,
   (5) Structure of banking and credit facilities.

(b) Social infrastructure:
   (1) Schools—primary, secondary, high schools, colleges,
   (2) Medical institutions—hospitals, dispensaries, availability of doctors/nurses,
   (3) Recreation facilities; agencies promoting social welfare,
   (4) Agencies to serve the needs of weaker sections of the community including harijans, scheduled castes and tribes.

(c) Natural resources:
   (1) Rivers, tanks,
   (2) Forest resources,
   (3) Inland fisheries,
   (4) Mineral resources,
   (5) Ports facilities,
   (6) Climate and rainfall,

(7) Soil conditions,
(8) Subsoil water.

(d) Population and labour:
  (1) Population and division into age group,
  (2) Labour force,
  (3) Degree of unemployment,
  (4) Emigration and immigration,
  (5) Labour training facilities.

In order to collect the statistical information outlined above, it is first necessary to draw up a detailed proforma. Collection of data may be entrusted to district level officers and block development officers, *panchayati raj* bodies and co-operatives and local non-officials and elected representatives at the block level, if any. But it is desirable to have a trained team consisting of people equipped with some knowledge of statistical techniques attached to each development block to check up and supervise the collection of local data.

On the basis of the statistical information collected in this manner, a plan for the development of the block concerned, with the specific purpose of increasing production and employment should be drafted. This again has to be the work of the local officials as well as non-officials. Special mention must be made of the need for associating non-officials for this purpose. The views of the progressive farmers and entrepreneurs will have to be ascertained about the problems or activities which should be given priority in different blocks or areas. For this purpose an advisory panel of selected farmers and entrepreneurs representing different areas and subregions has to be constituted.

The draft proposals for block development prepared in this manner should have to be discussed in detail by the official and non-official groups with the representatives of co-operatives, local-self government bodies, banks and *panchayati raj* institutions; and then the final version will be presented to the block planning cell functioning at the level of the state planning boards.

Both at the stage of collection and processing of data as well as drafting and finalising the development proposals, the district collector should be responsible for supervision and guidance.

As regards finance for planning the development of blocks, the guidelines issued by the Planning Commission indicate that the financial resources for a block plan may be composed of united grants from the state government, Central grants under Integrated Rural Development (IRD) as a Centrally sponsored scheme, provision under the state sponsored schemes to be implemented at block level, local financial resources of block *samitis* or market committees and institutional credit.

So far as the financial responsibility of the states is concerned, it is suggested that to begin with, a certain percentage of the overall state plan outlay, say, about 10 per cent, may be annually preempted and earmarked as state assistance towards block plans. This amount may be distributed equally if the blocks are more or less homogeneous in character or allocated on a discriminating basis with reference to their needs and potentialities.

The amount needed for this purpose will have to be found by the states out of the overall state plan and will have to be shown under a new head called "State assistance towards block plan". Apart from these resources, resort may be had to institutional credit in the form of borrowings by market committees or co-operative institutions for financing the block plan. This should be considered as similar to borrowings of state enterprises which are treated as state resources. On the same lines, borrowings of local institutions for corporate investment inside the block may be recognized as part of block financial resources.

Limitations of Block Level Planning

Incidence of certain socio-economic evils such as unemployment, poverty, inadequacy of public health and educational facilities, etc., is particularly high in certain specific areas of the country. These problems have to be tackled necessarily at the level of a block. But whether blocks can constitute the lowest geographical unit for planning purposes—either state or National level—is a different matter. In reality, from this point of view, the scope for block planning is limited; this is because of the smallness of the areas. Thus big industries, hydro projects, highways construction are obviously outside block planning. The guidelines point out that the availability of iron ore or coal deposits in a particular block need not imply that the development of these resources should form part of the plan for that block. "It is no use stating that because of forest resources, a paper mill is a possibility, planning of such a project should really be done at the state level or National level." Since the block is a small area, if only development possibilities and development problems of that area alone are to be considered, then the scope for block planning becomes very restricted indeed.

Even as regards a social objective like implementation of egalitarian measures, it is doubtful whether the block can achieve much in this line. In fact, the guidelines indicate that certain laudable objectives like bringing about an egalitarian structure of ownership of assets or re-orienting the existing institutional or organisational structure will more appropriately fall within the sphere of responsibility of National/state planning rather than of block level planning.

Emphasis is laid on the importance of planning infrastructural facilities. This requires spatial planning for the location of roads, schools, factories, houses, etc., in such a manner that all people can use them to maximum advantage. If this is not done consciously, infrastructure investments of sectoral programmes would be made in a haphazard way and may not converge in desirable combinations at the most optimal locations. This underlines the need for "inter-sectorally integrated locational planning". Planning for this purpose calls for decisions about: (1) key projects and supporting subsidiary projects in an area, (2) provision of basic infrastructure—electricity, buildings, roads, marketing yards, warehousing; and social infrastructure like schools and dispensaries, and (3) setting up of organisations like co-operatives and service societies.

Obviously these constitute too tall an order for planning at the block level. The infrastructural facilities outlined above relale to a whole region; planning in this respect, therefore, has to be done for the whole region and not piecemeal for each block.

An important point on which the guidelines lay some stress is that the block plan should be related to the state plan. In stating that block planning should be spread over a period of seven years—two last years of the Sixth Plan and the five years of the Seventh Plan, the guidelines point to the need for synchronisation of the state plan and the block plan. This, it is said, is administratively useful and functionally, will be necessary. Again in the concluding para it is observed, "The Block Plan is not to be prepared in isolation but must be closely co-ordinated with State Plan".

But does co-ordination of the block plan with the state plan imply that the former should form the basis of the latter in sense that the state plans are co-ordinated with the National plan? This, however, may not be possible for the reason given earlier, namely, that the area of block planning will be narrowly circumscribed. The major part of the development measures like national highways, power development, large industries, minerals exploitation, higher education, etc., are of statewide importance and the block plan will have nothing to say on these. A block plan can aim at specific objectives in particular areas. Unemployment may be acute in one block, drinking water supply may be totally inadequate, there may not be any public health or educational facilities. In such a situation, specific programmes may be drawn up for the removal of these evils. These may form part of the state plan in the sense financial provisions will be made for tackling these problems. They may be in the nature of sub-plans like tribal sub-plans—but it does not mean that block plans will form the basis of the state plans or be co-ordinated with the state plan. Thus, it is not possible to have a state plan for Tamil Nadu incorporating 374 block plans. The fact that problems such as eradication of poverty and unemployment or minimum needs programme can best be tackled only at the micro level does not support the argument that for this reason the state plan or the National plan should have as its basis the block plans. If for achieving this purpose, micro approach is the only correct approach, then the logical conclusion is that we have to start from the family which is the lowest social unit. In reality, arousing the masses, making them work harder, educating them, providing necessary health facilities and employment opportunities are essentially soial welfare measures to be taken care of by the social service institutions and departments.

However, the blocks and the agencies attached to the blocks can be made use of for collecting the basic data necessary for the district and the state plan. The guidelines mention about a base line survey or a bench-mark survey which would facilitate an assessment of the prevailing situation and identification of the gaps. These surveys, the scope of which has been indicated earlier, would be in the nature of a detailed resource inventory, comprising four parts: (a) physical and biological resources; activities allied to agriculture such as animal husbandry, dairying, fisheries, agriculture, forestry, etc.; industries and industrial resources; (b) human resources—socio-economic conditions of backward classes—scheduled castes and scheduled tribes population; (c) infrastructure and institutions, economic and social overheads, credit and marketing facilities, etc.; (d) number of families below the poverty line.

In fine it may be said that block level planning is ideal if it is confined to very backward blocks or problem blocks and if it aims at suggesting specific measures for solving specific problems. The question whether separate block plans can be made to form the basis for the state plan needed to be further examined. Second, to begin with, the planning agencies which may be set up at the block level may be made use of for collecting basic data relating to the needs and potentialities of each block. This will be in the form of an inventory which can be used with advantage in the preparation of the district plan or the state plan.

District as the Planning Unit

While planning for a small area has its advantages, it is certainly not desirable to go beyond a certain limit. To go farther below the district except where other considerations such as employment creation or provisions for minimum needs call for attention, is ill-advised. The justification for having the district as the planning unit is that traditionally the district has been the administrative unit. The collector who has the chief administrative and executive officer at the district level has under his control various assistants representing the different departments of the state. These responsible officials are eminently fitted to advise on the local development needs and suggest worthwhile schemes for implementation. Further, most activities of data collection do not at present go below the district level. Taking all these points into account, it may be concluded that if total planning is to be partitioned, then, the special unit of low level planning should preferably be the district.

District planning aims at building up the state plan from the district level. While planning of this nature does not ignore the major economic ills of the country, it is in the main to be considered as part of the state plan. State plan would then be not a framework of development designed by government officials and planners at the top and enforced for administration at the district and local levels, but it would be based on the co-operation and support of the masses who will have a hand in formulating the development projects pertaining to local regions as well as in carrying out the project. Looking at in this manner, planning will be democratic and broad-based.

The district plan should cover the entire area of the district inclusive of blocks and municipalities in each district. Actual planning work should be entrusted to planning advisory committees at two levels: (a) block level, and (b) district level.

The planning advisory committee at the block level should consist of: the *panchayat* union chairman, who will be the chairman of the committee, presidents of *panchayat* unions: local M.L.A., and M.P., one representative of co-operative societies from among the village societies: chairman of any municipality in the block, a knowledgeable farmer, an entrepreneur, a social worker, a representative of women's welfare organisation, manager of a nationalised bank operating in that area; all extension officers in the *panchayat* unions; the taluk statistical officer and the block development officer.

This committee would meet periodically and make an overall review of the development of the block and recommend measures for efficient and optimum use of the resources for development. It should make recommendations for the development of agriculture, minor irrigation, animal husbandry, cottage and village industries, rural roads, rural water supply, education and public health facilities. Similarly the chairman of the municipalities in the block will give details regarding their budget for the next year and their development proposals.

These proposals are to be forwarded to the planning advisory committee at the district level.

The planning advisory committee at the district level should be the district development council consisting of both officials and non-officials. It should also have as its members the district level officers concerned with agriculture, superintending engineer and executive engineer concerned with irrigation and chairmen of municipalities in the district. Besides, the district planning advisory committee may appoint sub-committees for the various sectors of development which are of direct concern to the district. The collector of the district will have an overall supervision and control of the district planning advisory committees. These committees will meet once every month and examine the proposals received from the block advisory committees, fix up priorities for these proposals and send them in the finalised form at fixed intervals to the state planning board. The district planning advisory committee and the block level advisory committees are not expected to prepare fulfledged development plans for the respective areas. Their recommendations will be in the nature of proposals, but it is important that the priorities of these schemes are clearly indicated and the total cost does not exceed the limit fixed by the state planning body.

In order to co-ordinate the activities of the block and district advisory committees, it is necessary to have an officer of the state planning board in the grade of planning officer located at the district headquarters to report directly to the state planning body on the activities of these committees. He would, in fact, be a link between the state planning board and the local committees and officiate as the secretary or convenor of the district advisory committee. He will be responsible for providing necessary guidance in the matter of drawing up the plan proposals on the lines desired by the state planning agency.

The Steps in District Planning

The process of district planning and the incorporation of the proposals in the state plan would involve four stages:

(1) Demarcating the area of development coming within the scope of a district and distinguishing it from areas which are of statewide importance.

(2) Allocating the finance for development among the districts according to certain norms.

(3) Distributing the financial resources allocated to a particular district among the various schemes. These schemes are to be prepared on the basis of proposals coming forth from the district planning advisory committees and by taking into account the existing pattern of outlays and the need for development of the different sectors of the district economy.

(4) Reviewing and checking up the sectoral programmes of statewide importance.

Then meshing the district plan proposals with the sectoral programmes.

The Area of District Planning

First, the scope of district planning is to be defined. There are certain sectors or areas of development which directly concern a district; there are other areas which are of statewide importance. Agricultural development, minor irrigation, animal husbandry, fishery, primary and secondary education, village and district roads, small and village industries, public health and sanitation services come under the first category. The second category would comprise items like railways, power development, national highways, development of ports and harbours, industries, university education and medical and public health activities of a general statewide nature. District planning should obviously cover all the sectors which come under the first category. As regards areas of development which are of statewide importance, planning is to be done at the state level, but the economic impact of such projects on the districts is to be properly investigated and studied. On the average, the outlay on items under category I amount to about 40 per cent of the total expenditure on state schemes.

Fixing the Outlay for Each District

It is necessary to determine: (1) the total plan outlay for each district, i.e., for items under category I mentioned above; and

(2) the total for each district has to be apportioned among the various sectors of development.

To begin with, the total plan outlay for each district can be fixed only tentatively. Let us assume that a state's five year plan would involve an outlay of the order of Rs.1,500 crores. Of this, the items under category I would take up 40 per cent or roughly Rs.600 crores. This amount may be distributed among the districts on the basis of their population (i.e., per capita outlay should be the same in all the districts). This, however, is only the first step and the figure may be taken as a rough norm. In fixing the actual outlay, which may be higher or lower than the tentatively fixed amount, we have to consider the following points:

(i) The present per capita expenditure on category I items in each district. If it is low in one district and higher than the average in another district, it is only fair to make the allotment a little more liberally in the case of the former.

(ii) The next point to be considered is the needs of the people in each district indicated by the social welfare facilities available. The indicators that may be considered for fixing the rank of a district in respect of social factors are: number of houses per lakh of population, number of primary schools, middle and high schools and colleges per lakh of people in relevant age groups, number of hospitals, dispensaries, doctors and hospital beds per lakh of population and proportion of scheduled caste population to total population.

(iii) Economic factors would indicate the level of material well-being of the people and also the potentiality for development of a district. The position in this regard is reflected in district income, per capita income, proportion of agricultural and industrial income to total income, number of employed people, proportion of employed to employable people, length of surfaced roads, area irrigated, area under cultivation, electricity consumption per head, number of bank branches, average size of agricultural holdings, etc. The potentiality for growth of a district is indicated by the availability of natural resources—mineral and forest wealth—climatic and soil conditions, entrepreneurial talents and economic overhead facilities. Given the economic and social indicators it would be easy to fix the rank of a particular district. If a district has a low rank, but at the same time it has large potentiality for development, there is a strong case for increasing the per capita, allotment, and vice versa if the factors indicate an opposite condition.

While data relating to economic and social conditions may be found in published reports and official records, it will be necessary to collect information about per capita expenditure in each district on items of development coming under category I from government officers at the head of the several departments. It may be a little difficult to allocate the total expenditure on the different sectors such as industries, agriculture, education, animal husbandry, etc., among the districts, but if up-to-date accounts are maintained at the head office it would certainly be possible to get more or less a correct view of the position.

Allocation of Plan Expenditure Among Districts

The basic principle to be observed in allocating plan expenditure among the districts is that there should be balanced development among them. This would mean that special consideration is to be given to those which are economically and socially worse off than others.

It is necessary to fix an upper limit to the outlay for each district to ensure that the projects drawn up for each district are realistic and within the resources constraint. Otherwise, over-ambitious plans will be prepared incorporating a large number of the proposals suggested by district representatives without any regard to the financial implications.

Such an upper limit can be fixed by ranking each district with reference to per capita expenditure incurred in the past two years and the economic and social indicators. There will thus be three ranks corresponding to these three factors. Based on these, a composite indicator for each district can be determined. If this composite indicator is below the average it means that the district concerned deserves special consideration in fixing the outlay and vice versa. This may be illustrated by a hypothetical example of ten districts A to J given in the following table.

According to the table, all points considered, the rank of district D is 1 which means that it is better off than most other

Banking of the district

District *1*	*Per capita expenditure* *2*	*Social factors* *3*	*Economic factors* *4*	*Total (2+3+4)* *5*	*Composite indicator* *6*
A	2	6	3	11	2
B	9	9	7	25	10
C	6	7	4	17	6
D	1	2	6	9	1
E	10	5	9	24	9
F	8	4	8	20	8
G	5	3	5	13	4
H	3	8	1	12	3
I	7	1	10	18	7
J	4	10	2	16	5

districts in respect of most of the indicators. District C is in an average position and all the districts with a composite indicator of 6 or higher than 6 are below the average, district B being at the lowest level.

It should be observed that this ranking is only of a tentative nature. It has to be refined and improved upon in the light of current statistical data before commencing work on the annual or five year plan. The distribution of Rs.600 crores among the ten districts may be made according to the following principle:

(a) 60 per cent or Rs.360 crores may be distributed on the population basis, i.e., $\frac{T}{P} \cdot P_i$

where T is total amount to be distributed;
P is population of all districts; and
P_i is population of any particular district 'i'
$(i=1 \ldots 10)$

(b) 40 per cent or Rs.240 crores to be distributed on the basis of the rank of the district using the formula

$$\frac{T}{N}\left(1 + \frac{Z_i - \bar{Z}}{\bar{Z}}\right)$$

T is amount to be distributed (Rs.240 crores)
N is number of districts
Z_i is the rank of a particular district; and
$\bar{Z}$ is the average of the composite indicators (or rank) of all the districts. The term within parentheses shows

that weightage will be given in inverse proportion to the socio-economic standard of the district.

Using the formula the distribution of Rs.600 crores among the ten districts will be as follows:

Statement showing distribution of financial resources among the districts—a hypothetical case

District	*Population in lakhs*	*Amount distributed on population basis (Rs. lakhs)*	*Amount distributed on the basis of rank (Rs. lakhs)*	*Total amount distributed*
A	5.0	4500	873	5373
B	4.0	3600	4364	7964
C	3.3	2880	2618	5498
D	2.8	2520	436	2956
E	4.6	4140	3927	8067
F	5.3	4770	3491	8261
G	4.4	3960	1745	5705
H	3.6	3240	1309	4549
I	3.0	2700	3055	5755
J	4.1	3690	2182	5872
Total	40.0	36000	24000	60000

Distributing the Outlay Among the Sectors in Each District

The planning agencies in the districts are to be informed of (a) the amount allotted to them in respect of development schemes falling within their purview (Group I schemes) and (b) a rough indication of the distribution of this amount among the different sectors such as schools, public health facilities, rural roads, minor irrigation, small industries, agriculture, fisheries, animal husbandry, etc. Here the state planning board may make use of the pattern of outlays in the past plan period as a broad guideline. Alterations may be suggested—raising the outlay under one head or lowering it under another—by the state planning agency taking into account the current requirements and possibilities.

However, in this matter the priorities of the local people are also to be taken into account. This information may be obtained through the agency of the planning advisory committees at the block and district levels. These committees may be required to submit their proposals under the heads indicated in a proforma to be got ready by the state planning body. The proposals of the block and district committees should contain the following details:

(a) A brief description of the schemes falling under the different sectors.
(b) Amount of money required.
(c) Time required for completion.
(d) Economic effects of the schemes—contribution to income growth.
(e) Effect on other sectors.
(f) Non-economic benefits.
(g) Employment potential.

Sectoral Programme

Hitherto the annual as well as the five year plans have been drawn up at the state level by incorporating (after some pruning down and some revisions) the sectoral programmes prepared by the heads of departments—industries, agriculture, public works, power, transport, education, public health, etc. If district planning is to be meaningful, it is necessary to see to it that the proposals drawn up by the block and district planning committees are given due consideration in preparing the state plan. This can be achieved by the state planning board by linking up the district plan proposals with the sectoral programmes. How it can be done is indicated below.

A sectoral programme may not relate to any particular district—e.g., power development or university education. Such programmes or part of the programmes may be kept out for the present purpose. Some parts of a sectoral programme may directly concern the districts. Consider for instance the development programme for agriculture. Barring administration, research, agricultural universities and some other items, the rest of the programme will directly relate to the districts. All schemes falling under this category are to be culled out and listed and classified under different heads. Next important thing is to regroup these items of work according to the districts within the boundaries of which they fall. Thus if it is rural roads, or starting of primary schools or minor works, it will be possible to find out the location of these projects and the districts to which they belong and they can be assigned appropriately. Data from two sources would then be available:

(a) Plan proposals from the districts categorised into different sectors with indication of the costs.

(b) Schemes concerning each district under different heads (indicating the cost also) prepared from the sectoral programmes (covering the entire state) and prepared by the heads of departments.

Meshing Sectoral Programmes with District Proposals

The next thing to do is to link up (a) and (b) above. This is the major item of work and in fact the most important, to be done by the apex planning body of the state. At this stage, the state planning agency has to work in consultation with the heads of departments as well as a few competent representatives of the district committees of each district. They have to compare and study each item of work mentioned in the two sources; accept straightaway those items which are found in both the sources; modify the other items by examining their feasibility, urgency, and importance and eliminate those which are irrelevant or unimportant.

The final stage in this exercise will be the meshing of the programmes drawn up for each district with the programmes drawn up for each sector by the heads of departments. Thus road construction programmes or projects concerning development of small industries or animal husbandry should be made to fit in with the programmes drawn up by the public works department or industries department or the director of animal husbandry for the whole state. This obviously requires adjustments to be made in district plans as well as sectoral plans. It is important to ensure that there is no duplication or overlapping. If this is done properly, the total cost of the different district schemes spread over the districts but coming under the same major head such as education or agriculture would add up to the total cost figure indicated in the relevant sectoral programmes. The sum of the outlays on district plans and the plans relating to projects which are outside the scope of any particular district but which concern the state as a whole, will represent the total size of the state's plan.

District planning conceived of in this manner will be a counterpart of block level planning. The latter relates to sub-areas within the districts and aims at the specific objective of eradication of poverty or achievement of full employment by making best use of resources available in each block. Statistical information required for making an assessment of the needs and potentialities of the blocks can be made use of for district planning as well, but the latter differs from the former insofar as it becomes an integral part of state planning and represents an ideal approach to it. The state plan will then be not merely a sum of the programmes of sectoral development drawn up by heads of departments but on the other hand, will be the result of the integration of sectoral programmes and district development schemes drawn up in consultation with the leaders of society in local areas and organised local bodies. Planning thus becomes broad based and democratic.

CHAPTER 11

Administration and Planning

Contemporary low income countries of the world adopted planning for economic development about the middle of the present century after they had become politically free. They had inherited a system of administration common under the colonial regime when the state's main activity was regarded as management or the carrying on of day-to-day governmental duties involving collection of revenue, maintenance of law and order and execution of some essential or basic public works.

From the economic point of view, these countries had stagnated for long and their administrative system suited only a stagnant economy. When they acquired independent status, they realized the need for achieving economic freedom as well and adopted economic planning as the means to build up their economies quickly and efficiently. They were aware of the inadequacy of their administrative machinery, for purposes of planning, yet they were faced with a series of new development tasks and could find little time for reflection and adjustment of the government machinery. They had, therefore, to make modifications of a pach work nature and rest contented with what best use they could make of the existing system.

But that system was far from satisfactory. Even if there had been no planning, the administrative system as it was functioning in many of the underdeveloped countries in the fifties and sixties was defective insofar as it was transplanted from advanced industrial countries without any thought being given to their adaptability or suitability to poor ill-developed countries with an altogether different cultural, social and economic background. The quality of administration depends directly on the individuals who operate it and the people for whom it is operated. The well known and common defects are listed by Donald Stone as follows: Careless work, disregard for time, mishandling of cases or transactions, useless routines, failure to follow through, low productivity, unused reports, favouritism, overstaffing, understaffing, bribery, waste of resources, and technical incapacity, etc.[1] Bureaucratic practices lead to excessive centralisation and concentration of power and responsibility in the top level officers who have little confidence in their assistants and subordinates and for that reason are reluctant to delegate authority. This over-centralisation results in authoritarianism and needless long drawn out paper work, tendency to avoid quick decisions, inordinate review of transactions and duplication of effort. In fact, officers at the top, because of their ego-inflating habits and reluctance to delegate responsibilities and duties to their assistants take upon themselves more tasks than they can do well and are beset with more pressures and problems than they can bear or handle.

The process of economic transformation calls for a toning up or overhauling of the administrative machinery. In the first place, as the economy advances, the functions of the government multiply. Even in a free enterprise economy, with the development of industries, growth of urban centres, expansion of economic and social infrastructure, new problems come up such as labour management relationship, overcrowding in towns, need for providing educational and health facilities and for improving the means of communication, marketing and financial facilities and the like. Correspondingly, the number of government departments multiply, the civil service, judiciary and police service have to be expanded and a host of new administrative problems come up. It is, thus, inevitable that the simple system of administration which could confine itself to the basic functions of government should give place to a new, complicated, versatile and far more efficient government machinery.

Secondly, when economic improvement is attempted to be brought about by planning, it becomes necessary that the administrative system should have a different functional and organisational set up. When planned economic development takes place the demand on the administrative system changes. It is no longer administration in the simple sense, but administration of a more complicated nature which has to cater to the needs of a growing economy and play the active part of the entrepreneur in assessing resources, in allocation of resources among worthwhile channels of investment, fixing of targets and priorities in respect of investment, in controlling foreign trade and foreign exahange and the training up and supplying of a new set of officers, imbibed with a sense of responsibility and dedicated to the task of building up the national economy.

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[1] *Creation of Administrative Capability*, C. Stone Donald and Stone, Alice B., in "Strategy for Development", edited by John Baratt, David S. Collier, Kurt Glaser and Herman Monning, Heath and Company, Lexington, 1975, p. 112.

However, it is wrong to assume that administrative improvement necessarily precedes planned development or that economic planning should lead to administrative improvement. In reality, administrative reform is neither the cause nor the effect, but a concomitant of economic development. It is impossible for any economy to train up and get ready a whole army of development oriented administrative officers ideally suited to organize and operate the new economic system. Much can, however, be done by making adjustments in the existing govermental machinery where it is necessary and possible, and to train the existing old type or conventional type of government or civil servants in the new art of managing and supervising the economic and entrepreneurial functions of the government. For instance, measures can be taken to control wasteful expenditure resulting from proliferation of administrative agencies. Even in the existing administrative departments and branches of government the officers and their assistants may be given training in plan implementation or plan formulation. Budget practices can be improved and oriented to the needs of planned development, so that the officers in charge of preparing the budget every year would become conversant with the requirements of a development budget. Similarly, changes in accounting methods, improvements in local government administration, management of corporations, etc., may be introduced with a view to make the officers and civil servants of the old order get attuned to the needs of the changed system.

In the context of the present-day low income countries which have initiated the process of planned economic development, administrative reform should have wider implications. It must mean not mere improvement or toning up of the existing administrative system but improvement of the machinery of planning also, i.e., improvement of the methods and techniques of planning which they are practising. It quite often happens that a plan fails at the implementation stage not because of the inefficiency or defects of the administrative system but because of the faults and defects in plan formulation and drafting. The planners may be over ambitious and fix targets too high. They may be too optimistic in their estimate of financial and real resources that would become available for investment. Proper attention might not have been given to the inter-dependence of the sectors and so the effect and repercussions of the growth of one sector on another and other sectors would not have been worked out. Sectoral objectives would then conflict with one another. Quite often there is a tendency to identify wellbeing with national income and to assume that growth of national income is a function of investment only. On the other hand, the importance of real income and equitable distribution of income and the solution of basic evils such as unemployment and poverty are either ignored or are not given any serious attention. Yet another serious defect noticeable in planning in the early stages of development of low income countries is that the planners take for granted the administrative machinery. That is to say the planners do not bestow much thought on the question whether the administrative machinery would be capable of bearing the additional burden involved in development planning; instead it is assumed that administration would be available in the form and of the quality needed. The fact is that administrative machinery is very much an endogenous factor which should grow, develop and accommodate itself to the requirements of a developing planned economy.

Apart from these shortcomings there is a tendency on the part of the planning technicians to attach too much importance to the document itself and its bulk rather than its contents and the basic principles underlying it. Voluminous documents are produced with a lot of verbiage and platitudinous and ambivalent statements. What is required is terse, brief, logical and scientific documents free from ambiguities, support-ed by reliable facts and figures and conveying the ideas, objectives and methods in a clear, matter of fact style.

But reaction against verbosity should not be carried to the other extreme. We should have to guard against the tendency to assume that economic planning is mostly a matter of theoretical economies. Too much reliance on theory, the resort to mathematical methods of interpretation and the use of econometric model building have led to the estrangement of economic planners from the administrators. Modern sophisticated techniques have their uses but they are to be used as tools to serve a definite purpose and not introduced or developed for the sake of the technique as such. Obsession with such methods and their indiscriminate use result in planning cutting itself away from reality. As has been aptly observed in a United Nations study "all planners should recognize that economic considerations are intimately tied up with a large variety of non-economic variables. . . (on the other hand) administrators are not to be mere generalists, but integrating generalists, i.e., they should be able to co-ordinate the activities of the various agencies responsible for development."[1]

In fact one of the prime requirements of efficient plan administration is that there should be a close liaison between the regular administrative officers on the one hand and the planning staff on the other. Planning is a continuing process and the planning body and the administrative machinery responsible for carrying out the plan programmes both have to undergo continuous change and have to adapt themselves to changing circumstances. Studies which form the basis for the formulation of plan proposals and the preparation of the project itself are technical matters to be eutrusted to a technically competent body of experts. It is likely that in the initial stages this group of experts will be a distinct unit and may have a tendency to stand aloof from the traditional administrative staff. Yet it is necessary to integrate the technical and expert bodies with the existing government machine; otherwise the latter is not likely to change in the desired direction. The administrative machinery should not be allowed to remain static, but should be modified and adapted to fit in with the emerging circumstances and in conformity with the needs of planned development. This of course, implies the training of existing officers as well as devoting special attention to the recruiting of new and young personnel who will be conversant with the art and techniques of planning. As a result, the existing traditional administrative machinery would be changed from within and the government departments would become more development oriented.

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[1] "The Administration of Economic Development Planning", Economic Bulletin for Asia and the Far East, Vol. XVII, No. 3, December, 1966.

One possibility of bringing about this linkage between the planning body and the traditional administrative mechanism is through the annual budget. The budget that is prepared every year and presented to the legislature contains details regarding the various items of expenditure—revenue as well as capital—the anticipated collections of revenue from different sources internal borrowing and public debt management. Planned economic development which involves the creation of assets, both physical and human capital assets, also necessitates the assessment and mobilisation of financial resources and the apportionment of these resources among various items of developmental expenditure. To the extent there is some common ground between the regular government annual budget and the plan budget, a coordination between the two is not only feasible but necessary. But the difficulty in this regard arises from the fact that in many under-developed countries the planning agencies did not have until recently, any say in financial administration. Further, from the planners' point of view the budget details were not comprehensive enough and the classification of the items of receipts and expenditure was different from that in the plan budgets.

Of late, the newly developing countries have adopted annual planning which requires the preparation of annual plan budgets. This has facilitated the coordination of the plan budgets with the regular government annual budgets. When this is done (in fact this is the practice in many countries) the budget forms the basic instrument of annual plan implementation. But it necessitates modernisation of the form and content of the budget. One important and necessary step in this direction is the adoption of programme and performance budgeting which involves the measurement of performance efficiency in management in both physical and financial terms. Another improvement is the preparation of an annual resources budget and its close synchronization with the government budget.

Apart from budgetary reform and the integration of the administrative organisation with the planning organisation it is possible to raise the level of efficiency of planning by meeting certain basic requirements. One is the need for filling up the statistical gaps and taking steps for ensuring the supply of adequate, reliable and timely statistical information. Although some progress has been made in the last one or two decades in improving the situation, yet lack of data still remains the major obstable in the way of planners in preparing project proposals, in fixing targets and in estimating resources availability. In many of the low income countries, the form in which national income data is made available leaves much to be desired. For practical planning purposes, it is necessary to develop a system of social accounting and a flow of funds analysis which would provide a complete picture of the generation of income in the different sectors of the economy and the absorption or utilisation of the income. With the gaining of experience in the collection and presentation of national income data along these lines it would be possible to organise and prepare input-output tables for the developing economies which would be invaluable for sectoral planning as well as for overall national planning.

Another gap is the lack of an adequate supply of technical manpower for planning work. It is important to estimate the different categories of personnel required over a fairly long period of time and then take steps to ensure an adequate supply. Providing pre-service and in-service training in the existing government departments would improve the competence and develop the motivations of the personnel, but this is at best a short-term measure and would not be a permanent means of meeting the need. For this purpose the educational system of the country has to be redesigned and modified. As the economy expands and development planning becomes more comprehensive, a large number of different categories of experts will be needed—administrative generalists, development planners, budgeting and programming staff, tax and finance specialists, managers and evaluators, city and urban planners, etc. At present, facilities for the training of such experts are available in some schools and technical institutes, colleges, universities and government training centres. But their existing capacity is to be properly assessed and the scope for their expansion in relation to the need for the personnel is to be ascertained. Such an assessment would provide the basic information needed to draw up a comprehensive programme of educational reform involving, opening of new courses in schools and colleges or the setting up of new technical institutes or special universities by the government. Equally important is research. Scientific and technological research can contribute to the improvement of development planning, as well as to the reform of the administrative system and operating practices. Apart from this, the institutes which specialise in these fields of research would become an important source of supply of highly qualified and competent experts in planning techniques.

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